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ENGINEERING AND MINING JOURNAL

A Consolidation of Engineering and Mining Journal and Mining and Scientific Press

METAL AND NON-METALLIC MINING · MILLING · SMELTING · REFINING · MARKETING

Fundamental Hoisting Problems - II

By Allan B. Calhoun

Staff Report of the Denver Meeting

American Mining Congress

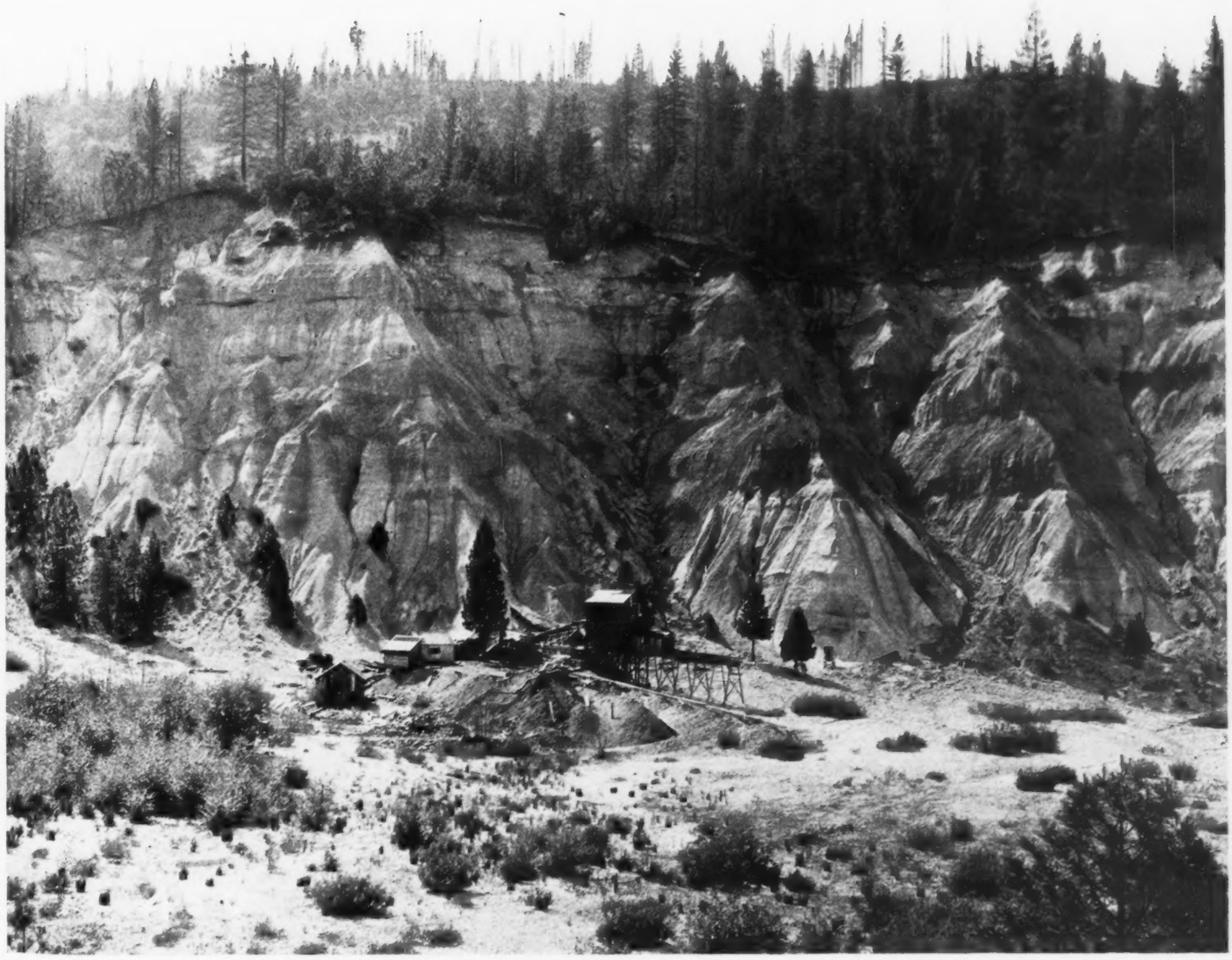
American Institute Mining & Metallurgical Engineers

American Association Petroleum Geologists

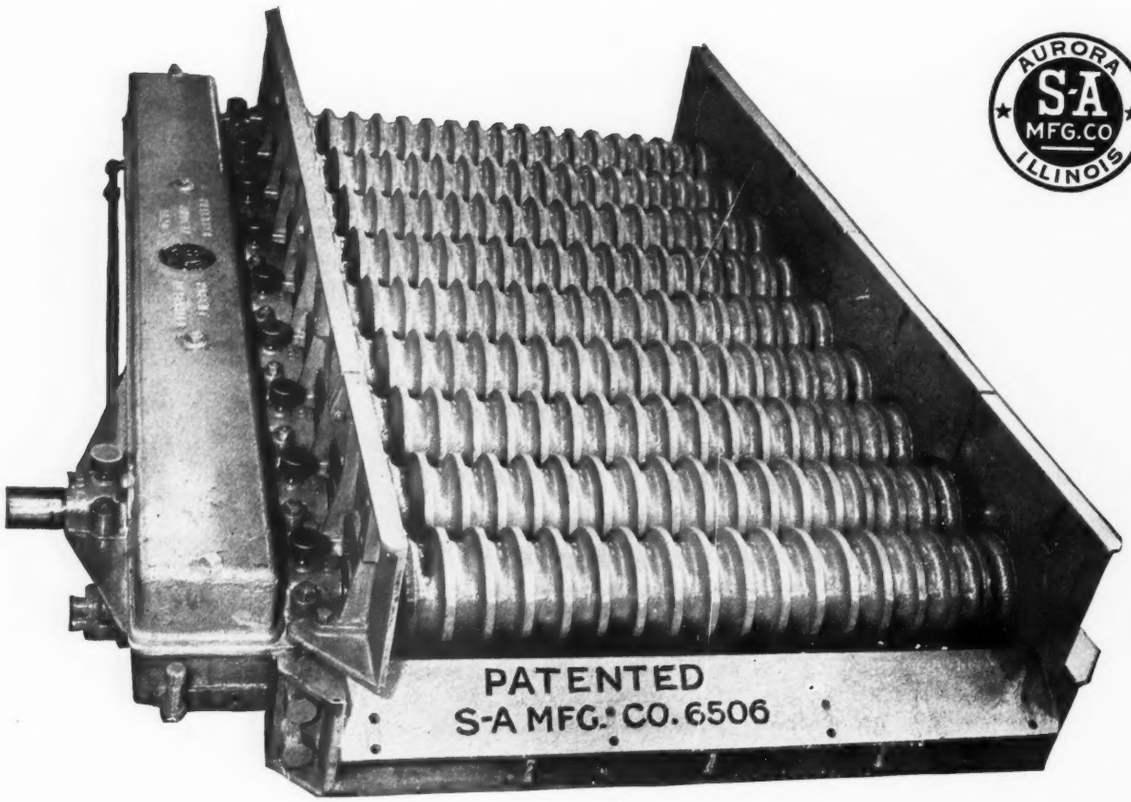
American Silver Producers Association

Estimation of Ore in Copper Mines

By Albert A. Leach



WEST BANK OF THE BLOOMFIELD HYDRAULIC MINE IN CALIFORNIA



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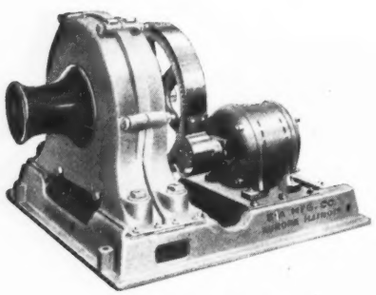

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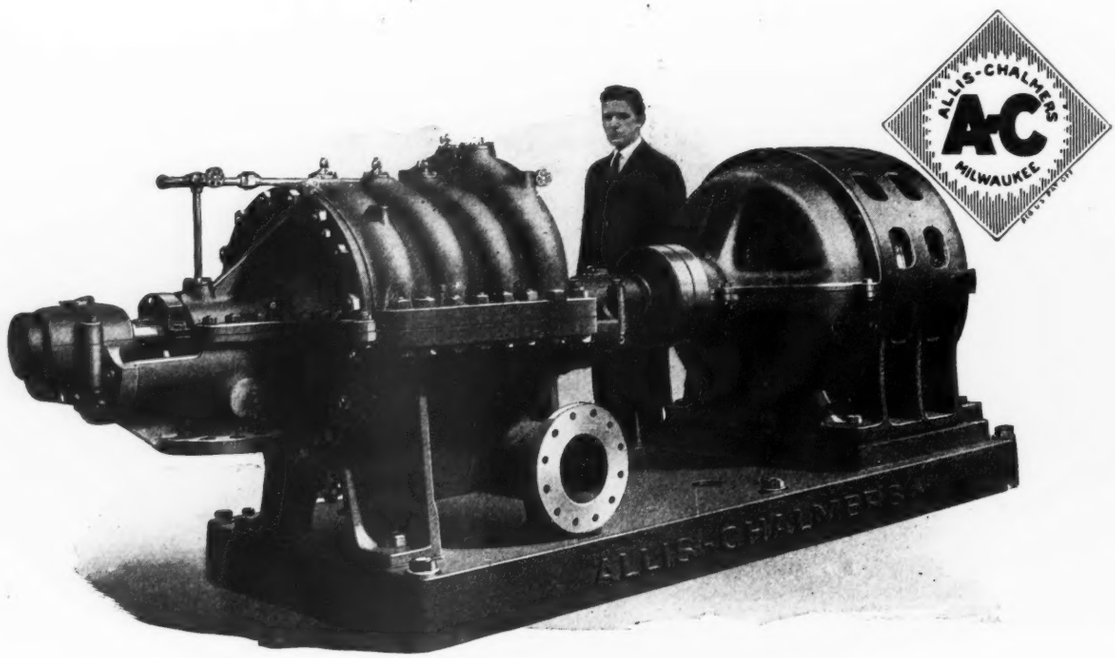

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ENGINEERING AND
MINING JOURNAL-PRESS

JOSIAH EDWARD SPURR, Editor

Volume 122 New York, October 2, 1926 *Number* 14

Potash in Texas

THE GREAT INTEREST in the development of further sources of potash in the United States, shown by the Congressional appropriation which is to be expended in drilling by the Bureau of Mines, renders of great interest the little U. S. Geological Survey bulletin on Potash Investigations in 1924, by Walter B. Lang, published recently. The area which is regarded as a potential source of potash lies in western Texas, 500 miles from Galveston, the nearest great shipping port.

The existence of potash in this area was first definitely proved about twelve years ago by Dr. J. A. Udden, of the Texas Bureau of Economic Geology and Technology. The suspicion arose through comparative stratigraphy, for the Permian strata of western Texas are correlated with the Permian in the Stassfurt region of Germany, where great potash deposits are mined. A deep test hole in Dickens County, Texas, yielded brines from a depth of 2,200 ft. which contained 5.4 per cent of potassium and this started the further efforts at investigation of which the proposed work by the Bureau of Mines is the latest.

During 1924 the Geological Survey pursued field investigations, and made studies of wells that had been drilled primarily for petroleum. The result was the establishing of appreciable quantities of potash in many wells, situated in a number of counties in Texas, so that the author feels that the data "strengthened the conviction that the presence of commercial beds of potash in Texas and possibly in Utah will be proved when suitable means are utilized to demonstrate the facts definitely." This is a most encouraging opinion, and a more definite one than the Geological Survey has hitherto allowed itself to make. The well records showed all the way up to 22.9 per cent of potash. The drillings indicate the existence of a number of beds of polyhalite, the complex salt which is one of the chief sources of potash in the German deposits. Carnallite, another of the potash salts of Germany, has been found in Grant County, Utah, at a depth of 3,150 ft. and deeper.

Three attempts by the Geological Survey to drill for potash, in Texas and in New Mexico, in 1917, failed to yield results: but this, it is believed, was either because there were not sufficient funds to go deep enough, or because the sites chosen were unfortunate. Since then, however, the "wildcatting" stimulated by the development of four oil fields within the salt area, has furnished abundant and definite data as to the widespread existence of potash salts in this field.

As to mining conditions the bulletin states that "There is little reason to believe that the geologic conditions in the potash area of western Texas offer difficult problems to the mining of the potash salts. So far as known at present, mining will be necessary to extract the potash, as the mineral polyhalite, which carries the potash, is relatively insoluble in comparison with the associated halite" (common salt). Mining methods are necessary in Germany, and in the Tertiary deposits in Alsace: in Germany it is necessary to mine at depths of 3,500 to 5,000 ft.: in Alsace, on the average 1,700 to 2,200 ft.; whereas in western Texas commercial ore is indicated at as shallow a depth as 900 ft., and the maximum appears to be 1,800 ft. The author finally states with regard to the beds of potash-bearing salts in Crane County, Texas: "Their favorable composition, combined with their relatively shallow depth, places them in favorable comparison, from the miner's standpoint, with the deposits of Stassfurt and Alsace." This is a bold and definite opinion, the realization of which would mean a great deal to the country. Under the circumstances the further investigation of the Bureau of Mines will be awaited with interest; and it would be expected that plans for attempting commercial exploitation should be under consideration.

Increasing Prosperity for the Metal Miner

DIVIDENDS paid by mining companies have been constantly increasing of late, and monthly payments to shareholders are well above what they were a year ago. Metal prices so far this year have ruled somewhat above those of 1924 and 1925, with few exceptions, but this is not the only reason, in fact, perhaps not the chief reason, why the mining industries are more prosperous. Decreased costs, due to improvements in methods and practice, are probably the most important factor. And of these improvements, the outstanding one is the great development that has taken place in flotation practice, making possible an increased ratio of concentration and a separation of various minerals that heretofore had to be smelted together. The enormous consumption of metals has also helped the industry, for the more metal that is sold, the more ore must be mined, and the more mining companies must be active.

Among the mining companies that have had a particularly prosperous period is the American Smelting & Refining Co., a company that is of special interest because of its widespread operations, and because of its dealings with so many small operators. Its net income has increased from $6,000,000 in 1922, to $9,000,000 in 1923, $11,000,000 in 1924, and $15,000,000 in 1925, and is credibly reported to have been at the rate of between $17,000,000 and $18,000,000 in the first half of 1926. Probably most of this income has been derived from the mining operations of its subsidiary companies, but a fair share has certainly come from its custom smelting business. It would seem that the company could afford to be generous in its smelting tolls. A good investment could be made in a further cultivation of the good will of the small miner by not only making charges as reasonable as possible, but also by giving full benefit of the increased recoveries possible by modern processes of treatment; that is, by gradually reducing penalties.

The prosperity of the small operator will be a valuable asset to the smelting company; the more ore he ships the more there will be to smelt, and the more assistance he gets in the way of favorable smelting contracts in the early stages of his operation the more chance there is of his being a steady producer afterward.

The small-scale miner, of course, profits by higher metal prices, but to profit from increased demands for metal, and from increased metallurgical skill, he must depend to a large extent on his treatment by those to whom he sells his ore.

Improvements in Flotation Practice Affect Smelting Methods

BLAST-FURNACE SMELTING of copper ores continues to be of gradually receding importance in America. To be sure, the Mason Valley plant, an exclusively blast-furnace smelter, recently resumed operations, but presumably it was necessary there to make use of existing equipment, construction of a new reverberatory not being warranted by the ore supply nor by the funds available. Were it not for pyritic and semi-pyritic smelting, by which a substantial proportion of the sulphur content of an ore is used for fuel in place of coke, blast furnaces would not have persisted so long as they have. But it is significant that even at two important pyritic smelters, where extremely low percentages of coke have been carried, the trend is toward reverberatories. The United Verde Copper Co. at Clarkdale, Ariz., is now doing most of its smelting in reverberatories, and the Granby smelter, at Anyox, B. C., until recently an exclusively blast-furnace plant, now has, it is reported, only one of its blast furnaces in use.

Differential flotation, of course, is largely responsible. By recently improved methods it has been found possible to remove a substantial amount of the barren iron sulphide, of no value except as fuel in the former method of smelting. The concentrate is much enriched in copper, and is too fine for blast-furnace smelting. It is possible, of course, to sinter such material for blast-furnace smelting, but the high sulphur content is likely to cause difficulties, and the customary and usually cheapest method is to roast the concentrates and smelt them in a reverberatory, or possibly smelt them direct, without roasting, as is now done at Cananea. More fuel is required, the best reverberatory practice requiring about 2,000 British thermal units in fuel oil to smelt a pound of ore whereas the best pyritic practice requires only one-half to one-fourth this amount in coke; but a substantial amount of the heat developed in a reverberatory is recovered by boilers in the flue, whereas that coming from the blast furnace is usually a total loss.

Forty Years On the Rand

IT WAS IN 1886 that George Walker accidentally stumbled onto an outcropping conglomerate, partially covered with grass. The character of the rock was unknown to him but he had his suspicions. He crushed the sample, panned it, and found gold. He secured permission from the owner of the Langlaate Farm to prospect for gold. He continued his quest for a few months until his working capital was exhausted. While absent endeavoring to secure additional funds his secret became public property. Thousands of claims were staked on the Rand, extending in an East and West direction for one hundred miles. Johannesburg was founded.

Forty years have passed. The city has a population of about 300,000 and is the center of the greatest gold mining area in the world, which produces more than one-half of the world's gold supply. Approximately 550,000,000 tons of gold ore has been treated during this period, producing gold valued at £856,500,000. Of this amount £664,000,000 has been expended in South African development and operating mines, building railroads, and creating a self-sustaining nation. In 1910 the production was approximately £32,000,000 whereas for 1924 and 1925 it exceeded £40,000,000 per year and this year's production establishes a new record nearly every month. Notwithstanding the fact that this enormous tonnage has been taken out, the developed ore reserves in July, 1926, were about 100,000,000 tons, varying from 6 to 11 dwt. per ton. By careful and refined treatment of the ore, the gold extraction is 96 per cent. Maps of these great mines show that during this forty-year period 3,300 miles of underground drifts, cross-cuts, etc., have been driven in the gold-bearing reefs. Although the Village Deep mine has attained a depth of about 7,000 ft. the bottom of the gold-bearing reef has not been reached nor has mechanical equipment limited the depth to which mining may be carried. Underground hoists are being installed in Michigan copper mines on the 81st level, with a capacity of 3,000 ft. additional depth.

Improvements in mining methods, machinery, and equipment as well as better metallurgical processes continue to reduce costs and as costs decrease, a lower grade of ore can be milled at a profit. It is in this direction that hope lies for prolongation of the vast gold-mining industry upon which the prosperity of South Africa rests.

Mining As a Business

THE DISAPPOINTED, foot-loose mining engineer who has accomplished success—for the owners of the mines where he has worked under salary—but who is looking for a job all over again at a moderate salary, continues to be a common phenomenon. This brings up the question what a mining engineer hopes and plans to do with his career, when he leaves the technical school and sets out upon his strenuous experience. He has a clear idea that he is a professional man, that he will perfect himself in technology, solve all the problems of technology and management which may come to him, and conduct himself so that in the matter of ethics there may be no reproach. He passes through long periods of service, in many cases to men whose technical knowledge does not exist and whose ethics are not those which he holds. If he makes a success for them, they pay his salary, and perhaps raise it, or give him a bonus: if the enterprise is a failure, or if climate or altitude or other conditions tell upon him, or if his children need school and a mother's care at the same time, middle age may find him at loose ends as to his future and his cash-box. All the money he may have earned for various employers does not improve his credit at the bank; he is not experienced in mining as a business, but only as a technical art.

The mining engineer has suffered much from the belief that mining is a profession: whereas it is an industry—a business. It is not to be compared—even in the practice of mining engineering, or metallurgy, or mining geology—with the old professions, like medicine

or the law, or the waning profession of the ministry. The mining engineer may not sit in his office in New York, with a string of callers in his waiting room—"cases" who will automatically deposit fifty to five thousand dollars in his cash-box as they pass through. Any consulting engineer who has tried to get paid for valuable advice knows that his efforts are greeted with injured and shocked surprise—unless indeed he journeys forth and makes an "examination." What the mining engineer, the metallurgist, or the mining geologist is paid for is for conducting or guiding part or all of a going business. Hence the conscious aim of a young graduate should be to get into this business—to be independent, or a partner, or an employer, eventually. A great deal of hesitation and prejudice on the part of some of the older engineers—a noble and competent group—stands in the way of this conscious effort. But surely mining can be better conducted by engineers than by many of those who do conduct it. And being a business to which the engineer's life is devoted, should he not rise in it, as well as in the technique of conducting it? Therefore engineers may be advised to go into mining, not aloofly, but with both feet—to invest in mines, either as stock or an interest, either with their earnings or as a compensation for their services: to undertake, conduct and promote mining enterprises when and where they can. The question of ethics need not retard them. If a man is honest and practices the golden rule; if he loves honor and fair play better than cash, he will know what to do and how to meet every problem which arises, as it arises. It is only fair that the splendid service which our mining engineers are rendering to their industry should be encouraged and compensated: and this may be accomplished by their consciously determining to be business men.

All-Service Gas Masks

AT THE RECENT SAFETY MEET in San Francisco, J. T. Ryan discussed the development of modern types of gas masks and exhibited an all-service gas mask. This ingenious device has been made possible by the discovery of an effective catalytic which in the presence of oxygen and the absence of moisture will bring about the oxidation of carbon monoxide to carbon dioxide, or, in other words, will convert a toxic gas into a comparatively innocuous compound. During the war efficient absorbents were found for many poisonous gases but there was no known absorbent for carbon monoxide gas. However, this deadly gas has finally yielded to persistent research and adequate protection has been found for those who have to enter and work in an atmosphere in which carbon monoxide occurs as an important constituent. Nevertheless, it is essential to point out that it is vitally important that such masks be not used in an atmosphere greatly impoverished in its oxygen content. Any atmosphere that will support the flame of an oil lamp or a candle and containing poisonous gases can be safely entered under the protection of gas masks containing suitable absorbents and the catalytic for the conversion of carbon monoxide to carbon dioxide. Bureau of Mines tests prescribe certain percentage limits, as for example: air containing acid gases, organic vapors or carbon monoxide not exceeding 2 per cent by volume, ammonia not exceeding 3 per cent, and in smoke, dusts and mists; or not over 2 per cent of poisonous gases when more than one gas is present.

The all-service gas mask is a distinct achievement of the safety-appliance manufacturer and the research chemist. It increases the facilities for work in dangerous atmospheres and deserves a place alongside of the modern oxygen apparatus.

Emotionalism in Mining Investment

FOR THE SUCCESS of any investment the enterprise into which money is paid must be practical and economically sound. A mining investment is by no means an exception to this generalization, although many devotees of mining and mining investment do not subscribe to this view. Emotionalism and investment have nothing in common: yet it is precisely emotionalism which is cherished and preached by many. "Never mind what the mine looks like—have faith, enthusiasm, courage—talk big, and everything will turn out fine in the long run," is their slogan. To be sure, it is Other Peoples' Money many of them are so courageous with; but the emotional basis of mining investment is found not only among the exhorters, but among the real investors, and even among the men who do the real mining, and contribute their own hard labor. A practical miner remarked a few weeks ago that he had a wonderful showing in the development that he was doing. He reported that engineers visiting the mine from near and far were amazed at it. In answer to the question as to what the values were in the supposed ore he had developed, he replied that he had not bothered with that as yet; but he had a truly wonderful showing. A miner, or a mine owner, is like the father of a first child: he knows the good points of the mine better than the bad ones. In answer to the question, "How much does your ore run?" over fifty per cent of honest mine owners will answer that they have had assays up as high as such and such a figure. If they are asked, by way of striking an average conception, "What was your lowest assay?" a more or less resentful grumble is the response. Optimism is a pleasant pastime, even if sometimes a foolish one; and the mine owner may be allowed to indulge in it, if it gives him the courage to go on, which is often necessary that all the possibilities may be explored. But in investing, or in offering investments to others—to capitalists, pensioned clergymen, widows and orphans and boot and shoe dealers—emotionalism is out of place. The investment should be analyzed on the facts, present and prospective. To get at these a cold-blooded analytical outsider must come in—namely, the trained and experienced engineer. Engineers are like doctors; they are good, bad and indifferent. In both cases, if you call in a bad one you will be sorry, or someone will be; in both cases, if you get the best, you will do the wisest and happiest thing that could be done. Stock flotations should not be made without being accompanied by the analyses of the best engineers—engineers impeccable as to honesty as well as experience. In mining ventures, it happens now and then that engineers so engaged are bought by the promoters to make the kind of report they desire; even engineers of ability, who know better, fall to this temptation, and should be doubly damned because of their higher knowledge. But there are plenty of honest consulting engineers—as there are honest doctors and lawyers—who are also competent; and much as some enthusiastic mine owners may present their cold-blooded analysis, such common-sense tests are the only guide to safe and reliable mining investments.

Fundamental Hoisting Problems—II*

Electric Power; Choosing the Motor and Type of Control —Safety Devices—Cage and Skip—Hoist Data

By Allan B. Calhoun
Mine Superintendent, Burma Corporation, Ltd., Burma

IN CONSIDERING TYPES OF HOISTS—that is to say, electric, steam, or air-driven—I shall discuss only the electrically driven hoist, for the reason that there is little that is new to be said about the steam or air hoist, and, although there are instances where large hoists can be more conveniently operated by steam, in most cases electric power is more suitable.

The electric hoist has passed beyond the experimental stage, and now, after twenty-five years of rapid development and improvements, is considered the most efficient and cheapest where power can be obtained at a reasonable price. It is permissible to think that in the future all large hoists will be operated by electricity. This is indicated by its rapid adoption in place of steam or air hoists in nearly all countries.

Advantages of the electrically operated hoist are as follows:

1. Lower first cost.
2. Lower cost of energy per ton hoisted.
3. Lower consumption of oil, waste, and grease.
4. Lower cost of repairs and maintenance.
5. Absence of stand-by losses.
6. Smooth acceleration.
7. Safety.
8. Simply controlled.

Of all commodities, electric power is one among the few whose cost did not go up during the war, but was kept down, and today in many localities it is less than it was before the war. The electric hoist is especially adapted to localities where power may be purchased from central stations. Here the cost is generally reasonable, provided the power company does not object to short peaks, and the capital cost of hoist equipment is small. In the deep mines of Africa, the hoists are nearly all electric and have been found cheaper than steam. Electric hoists on the Rand total 74,000 hp., an average of 517 hp. to the hoist.

The electric hoist is also well adapted for colliery work, where there is a large supply of cheap coal. The high-speed condensing turbine has now become so economical and reliable and occupies such a small space that the production of electric power by a turbo-generator and flywheel has become common practice. In many instances the power so produced is cheaper than hydro-electric on account of small capital expenditure and the short life of the mine. This is becoming more so in England and on the Continent.

The electric hoist is also well adapted to localities where the cost of fuel is high on account of inaccessibility to coal field or railway, but where hydro-electric power can be obtained. The deep mines of Kolar gold field, in India, are now falling into line. It is also adapted to places where small hydro-electric plants can be installed. When the capacity is small and just sufficient to furnish power for the mine on an average load, an equalizing set is often necessary to keep down the peak load and prevent making the system objectionable for other uses besides hoisting.

A new system has lately been installed in England called the Metropolitan Vickers, Stubbs Perry system, in which two units, the turbo-generator set and motor-generator set of the Ward-Leonard-Ilgner system, are combined. The steam turbine takes the place of the induction motor of the motor-generator set. In this particular installation, on account of the high peak load, the performance has been so good that a duplicate has been ordered for another shaft. On account of the low steam consumption, the future of this system is said to be favorable. However, the unit referred to is new and very large, and it is too early to say much.

Types of Electric Hoisting Motors

Two classes of motors will be considered; namely, alternating current motors, connected to the main power line, and direct-current motors, most generally operated by power from a motor-generator set and often in conjunction with an equalizing set.

The alternating-current motor direct-connected to the drum shaft is the cheapest, most compact and simplest of all types, but is being superseded by the motor geared to the drum for the following reasons: In order to couple the motor directly to the shaft, the motor must be low-speed, and a low-speed induction motor must be made large, and consequently is of low efficiency and poor power factor. Only in large shafts with heavy load and rather high speed would it be justified. Instances of direct drives are as follows:

Mine	B. Hp.	Voltage	Depth of Shaft, Feet,	Speed, Feet per Minute	Net Load, Pounds
City Deep (Rand)	3,400	2,000	4,000	3,500	10,000
Brakpan (Rand)	3,000	2,100	3,800	3,500	10,000

Since double-helical gears are now being made with an efficiency of 95 per cent and over, nearly all a.c. motors driving a hoist are operated through gears. This permits the use of a smaller slip-ring induction motor of high speed and efficiency. It is satisfactory for small, medium-sized plants with cheap power supply and light loads and slow speed hoisting.

With regard to both direct-connected and geared a.c. motors, the efficiency of the a.c. motor hoist is 45 per cent, on account of large loss in acceleration.

The electrical equipment of both the direct-connected and the geared a.c. motor consists of the motor, a rotor controller, stator-reversing switch (operated by the same lever), the main switch, and all necessary safety appliances.

The rotor controller is generally a rheostat placed in the rotor circuit, and is one of three types—namely, the drum type, the contactor type, or the liquid type.

*The concluding installment. Part I appeared in last week's issue.

The drum type is suitable only for small hoists. The contactor type (not generally used) consists of a metallic resistance that requires much space. One advantage of it is that should the driver throw the lever clear over into the running position, the acceleration will be only a definite rate up to full speed or whatever position the lever is in. The liquid type of rotor controller is used in the better installations in Europe, as it is the cheapest and most compact and gives a gradual acceleration over the whole range. There are two types of liquid controls, the weir type and the movable-electrodes type.

The weir type consists of two tanks, one the storage tank with electric motor and the other the upper tank with fixed electrodes. The electrolyte is pumped from the lower tank, and flows back through a weir controlled by the driver. When the driver's lever is pulled clear over, the weir is fully raised, and the electrolyte rises and gradually immerses the fixed electrode, so that the resistance is gradually decreased. This type has the advantage of automatic acceleration, but is expensive and is mostly used by large hoists.

The movable-electrodes type of liquid control consists of a tank containing three fixed electrodes, each inclosed in an insulated pot with a movable electrode which can be lowered by means of the driver's lever. This seems to be the coming type, but automatic acceleration cannot be obtained.

The stator reversing switch is generally of the contactor type and is out of the driver's direct control, as it is operated by a small switch connected to his lever. It is made in three different forms—namely, the oil-immersed electrically operated switch; the air brake; and the air-brake electro-pneumatically operated.

The oil-immersed switch is used for 200 hp. and under. It is compact and totally inclosed, and consists of two type pole contactors immersed in a tank of oil.

The air brake form is used for low voltage and high current. Contactors are standard triple poles inclosed in a sheet-steel cubicle. For large hoists (voltage 2,000 to 3,000) two type pole contactor switches on panels with large clearance with arch shields and blowouts are used and are generally placed in a separate room.

The air brake, electro-pneumatically operated, is used for largest hoists and high-tension work. A complete set consists of six units, three of which are used for each rotation, and each switch is operated by compressed air with valve controlled by solenoid.

The simplest system of electrical braking is the reversed or counter-current method in which the supply of current to the stator is reversed so that the field of rotation is opposed to that of the rotor. Energy returned from the rotor is dissipated in the controller in the form of heat. Though easy to control it is wasteful. Even when lowering a load out of balance, power is taken from the line.

The regenerative method of braking allows the motor to attain a super-synchronous speed when acting as a generator and return power to the line. Although this is economical, it is not recommended, as it is difficult to bring the hoist to rest.

Rheostat Control Not Safe Beyond 1,500 Ft. per Minute

Summarizing, in the case of a.c.-motor-operated hoist, rheostat control is not safe for speeds beyond that which can be controlled by mechanical brakes, and this is generally 1,500 ft. per minute. Where capacity can be obtained under this speed rheostatic control is quite satisfactory. The motor will work up to double horsepower in starting. The upkeep is small and the efficiency during the period of full speed is 90 per cent.

In South Africa, where the power distributing system is extensive, the companies do not object, as one peak balances the other.

Mine	Motor, B. Hp.	Voltage	Depth of Shaft, Feet	Speed, Feet per Minute,	Net Load, Pounds
Robinson Deep, Ltd., (Rand)	2,000	2,000	4,500	2,000	14,000
Geldenhuis Deep, Ltd. (Rand)	2,000	2,000	4,000	2,000	10,000
Village Deep (Rand)	2,000	2,000	5,351	2,500	5,400

Rheostatic losses in starting are very high; often half the power supplied is dissipated in the starting resistance.

Except in unusual conditions of heavy load and high speed, it is better to connect the motor to the drum shaft by gearing. Where there is a large fluctuation in the peak and the supply station is of small capacity it makes the system objectionable for other uses. The system is adaptable to cheap power, low speeds, and light loads.

Direct-Current Motors—Ward-Leonard Control

Hoist motors of the direct-current type are generally driven by direct current from a motor-generator set and controlled by the Ward-Leonard system. Under certain conditions the motors work in conjunction with a battery or flywheel as a load equalizer. Batteries permit a large fluctuation in speed, but are not satisfactory in practice and have been superseded by the Ilgner flywheel system.

The equipment called for by the Ward-Leonard system consists of a d.c. hoist motor; a motor-generator set driven by an induction motor with or without flywheel; an exciter; a Ward-Leonard field controller; and a slip regulator and safety devices.

The direct current from the separately excited dynamo is led to the armature of the separately excited hoist motor. The dynamo field is reversible, and can be varied from zero to full voltage in either direction by throwing in resistances which cause the pressure and current of the hoist motor to vary likewise from zero to maximum. The field controller is small and compact, as it handles only the small current supplied to the fields of the generator.

In hoists of medium size, the face-plate type of controller is customarily used. It is small and generally placed beneath the driver's platform coupled up to the driver's control lever and the cam gear for acceleration and deceleration. Varying the resistance in the field circuit changes the speed of the motor.

With large hoists that take a current that is too large for the face-plate controller, a contactor controller is used, which is much more expensive than the former.

The Ward-Leonard system without the flywheel requires a liquid starter. If it is used with a flywheel a slip regulator is required to allow the motor-generator set to slow up and permit the flywheel to give up its energy.

The Slip Regulator

Where a slip regulator is required for small hoists, the permanent resistance is often used, as it is cheap, although there is a continuous loss. In the auto slip regulator the resistance is increased or decreased according to fluctuation in the load. There are two

Electric Hoist Data, Covering Forty-four Installations

Mine	Depth of Shaft, Feet	Output in Tons Eight Hours	Net Load Per Lift, Pounds	Maximum Hoisting Speed, Feet per Minute	Number of Trucks Per Cage	Drum	Rope Diameter, Inches	Method of Driving	Power Supply	System of Control	Date of Installation
North Butte, Montana	4,000	2,000	14,000	3,000	Skip	Cylindrical, 12-ft. diameter 9-ft. 4-in. face	1⅛	d.c. motor	3 phase, 2,200 volts, 60 cycles	Ilgner flywheel, 50 tons	....
Miami Copper, Arizona	796	4,000	20,000	.....	Skip	Cylindrical	..	d.c. motor, s.r. gear	3 phase, 6,600 volts, 25 cycles	Ilgner flywheel, 24 tons	....
Silver King Coalition, Park City, Utah	1,100	.....	.....	1,630	....	.....	..	d.c. motor	3 phase, 2,200 volts, 60 cycles	Ward Leonard	....
Cinderella Consolidated Gold Mining Co	3,600	456	.....	2,056	....	.....	..	d.c. motor	3 phase, 6,300 volts, 50 cycles	Ward Leonard	....
United Verde, Arizona	1,700	1,833	16,000 max.	1,000	Skip	Cylindrical, 10-ft. diameter, 5-ft. face	1⅜	d.c. motor, s.r. gear	.....	Ilgner flywheel, 20 tons, 9½ ft. diameter steel plate	....
Santa Gertrudis, Mexico	.....	800	10,000	1,000	Skip	.....	1⅛	a.c. motor	3 phase, 440 volts, 50 cycles	.....	....
Homestake, South Dakota	3,230	.....	14,000	2,000	Skip	Cylindrical, 10-ft. diameter, 7-ft. 2-in. face	1½	d.c. motor	.....	Ilgner	....
New Orient, Illinois	607	12,000	22,000	4,000	Skip	Cylindrical, 10-ft. to 17 ft. diameter	2	d.c. motor	3 phase, 2,200 volts, 60 cycles	Ilgner flywheel, 45 tons	....
Butte, Montana	.....	.....	14,000	.....	Skip	Cylindrical, 9-ft. diameter, 8-ft. face	1½ long lay	d.c. motor, direct-coupled	3 phase, 2,200 volts, 60 cycles	Ilgner flywheel, 69 tons lam't'd	....
Geldenhuis Deep, So. Africa	4,000	.....	10,000	2,000	....	.....	..	a.c. geared	3 phase, 2,000 volts, 50 cycles	3 phase	....
Village Deep, South Africa	5,351	.....	5,400	2,500	....	.....	..	a.c. geared	3 phase, 2,000 volts, 50 cycles	3 phase	....
North Butte, Montana	4,000	1,600	15,680	3,000 to 3,100	....	Cylindrical, 12-ft. -9-ft. 4-in.	1⅜	d.c. motor, direct-coupled	3 phase, 550 volts, 60 cycles	Ilgner	About 1916
Utah Apex, Utah	900	600	9,000	1,500	....	Cylindrical, 7-ft. x 5-ft. 4-in.	1⅛	a.c. motor, s.r. gear	3 phase, 2,300 volts, 60 cycles	3 phase	1917
Harworth Main Colliery, Eng.	3,000	2,400	16,800	3,170	3 decks 3 cars to deck	Cylindrical-conical, 14-ft. to 26-ft. diameter	2⅛ locked coil	d.c. motor, s.r. gear	Stubbs Perry system	Ilgner flywheel, 22 tons	1923
Anaconda Copper Mining Co.	2,000	3,840	.....	1,475	....	Cylindrical	..	a.c. motor, s.r. gear	3 phase, 2,200 volts, 60 cycles	3 phase contactor	....
Witherbee, Sherman & Co.	1,000	960	.....	900	....	Cylindrical	..	a.c. motor, s.r. gear	3 phase, 440 volts, 25 cycles	3 phase, liquid control	....
Hecla, Idaho	1,200	1,200	.....	2,000	....	.....	..	d.c. motor	3 phase, 2,200 volts, 60 cycles	Ilgner flywheel, 14.5 tons	....
Butte, Montana	.....	.....	14,000	.....	Skip	Cylindrical, 12-ft. diameter, 108-in. face	1½ Ordinary lay	d.c. motor, direct-coupled	3 phase, 2,200 volts, 60 cycles	Ilgner flywheel, 55 tons	....
Butte, Montana	.....	.....	5,000	.....	2 deck cage	Cylindrical, 6-ft. diameter, 60-in. face	1½ Ordinary lay	a.c. geared	3 phase, 2,200 volts, 60 cycles	3 phase	....
Nundydroog, India	1,635	173(?)	2,000	966	2	2 drums, 10-ft. diameter	1⅛	a.c. motor, s.r. gear	3 phase, 3,100 volts, 25 cycles	3 phase	....
Rio Tinto, Spain	245	856	3,400	525	1	Cylindrical, 6-ft. 6-in. diam.	1⅛	a.c. motor, s.r. gear	3 phase, 3,000 volts, 50 cycles	3 phase	....
Powell Duffrin, South Wales	1,950	2,000	11,200	2,880	4	Cylindro-conical, 11-ft. 6-in. to 18-ft. diameter	2.069	d.c. motor, direct-coupled	3 phase, 3,150–3,300 volts, 50 cycles	Ward Leonard	....
Powell Duffrin, South Wales	960	1,142	5,600	1,650	2	Cylindrical, 10-ft. diameter	1½	a.c. motor, s.r. gear	3 phase, 3,000 volts, 50 cycles	3 phase	1922
Ocean Coal, England	2,610	1,710	11,200	2,910	4	Cylindro-conical, 12-ft. to 20-ft. diameter	1.9	a.c. motor, s.r. gear	3 phase, 3,300 volts, 50 cycles	3 phase	....
Mond Nickel, Canada	3,500	110	2,000	1,000	1	Cylindrical, 10-ft. diameter	1¼	a.c. motor, s.r. gear	3 phase, 550 volts, 60 cycles	3 phase	1916
Nova Scotia Steel & Coal Co.	500	576	2,240	923	1	Cylindrical, 6-ft. diameter	⅞	d.c. motor, s.r. gear	3 phase, 2,200 volts, 60 cycles	Ward Leonard	....
Pit in Durham	482	784	2,016	2,200	2	Cylindrical, 10-ft. diameter, 6-ft. wide	1⅞	d.c. motor, s.r. gear	3 phase, 5,000 volts, 50 cycles	Ilgner	1914
Canadian Collieries, Victoria, B.C.	1,000	2,070	7,800	2,880	2	Conical, 7-ft. 6-in. to 11-ft. 6-in. diameter	1½	d.c. motor, direct-coupled	3 phase, 2,200 volts, 25 cycles	Ward Leonard	1914
Newcastle, Australia	800	2,800	12,300	1,872	6	Cylindrical, 14-ft. diameter	1⅛	d.c. motor, direct-coupled	3 phase, 3,300 volts, 50 cycles	Ilgner	1913
New Sharlston Collieries, Sharlston West No. 3 Pit	600	1,480	4,032	1,836	3	Cylindrical-conical, 8-ft. to 13-ft. diameter	1 1/16	a.c. motor, s.r. gear	3 phase, 2,000–2200 volts, 50 cycles	3 phase	....
Dominion Coal Co., Nova Scotia, O'Neill's Point	708	3,600	11,200	2,526	2	Cylindrical-conical, 12 to 18-ft. diameter	2	a.c. motor, s.r. gear	3 phase, 2,200 volts, 25 cycles	3 phase	....
Taff Merthyr Steam Coal Co., Ltd., Treharis Upcast South	1,950	2,000	11,200	2,880	4	Cylindrical-conical, 11-ft. 6-in. to 18-ft. diameter	2 1/16	d.c. motor, direct-coupled	3 phase, 3,200 volts, 50 cycles	Ward Leonard	....
Taff Methyr, Downcast, North	1,950	3,600	16,800	3,600	6	Cylindrical-conical, 13 to 22 ft. diameter	2 1/16	d.c. motor, direct-coupled	3 phase, 3,200 volts, 50 cycles	Ward Leonard	....
Mysore Gold, Edgar Shaft, India	3,920	820	10,080	3,000	Skip 1	2 drums, 16-ft. diameter	1½	d.c. motor, direct-coupled	3 phase, 2,000-2,200 volts,	Ward Leonard	
Partridge, Jones & John Paton, Ltd., Chumlin, New Sinkings	450	823	3,360	840	1	Cylindrical, 8-ft. diameter	1 1/16	a.c. motor, s.r. gear	3 phase, 2,200 volts, 25 cycles	3 phase	....
Sheffield Coal Co., Ltd., Staple Pit	285	560	2,016	816	2	Cylindrical, 7-ft. diameter.	1	a.c. motor, s.r. gear	3 phase, 550 volts, 50 cycles	3 phase	....
Osborne & Chappel, Ltd., Menglembu Lode, F. M. S.	300	412	2,240	300	1 skip	2 drums, 4-ft. diameter	⅞	a.c. motor, s.r. gear	3 phase, 400 volts, 50 cycles	3 phase	....
Osborne & Chappel	300	412	2,240	300	1 skip	2 drums, 4-ft. diameter	⅞	a.c. motor, d.r. gear	3 phase, 400 volts, 50 cycles	3 phase	....
East Indian Coal Co., Ltd., Kendwadih No. 2 Pit	300	240	1,680	300	1	Cylindrical, 6-ft. diameter, 6-ft. wide	1	a.c. motor, d.r. gear	3 phase, 2,200–500 volts, 50 cycles	3 phase	....
East Indian, No. 3 Pit	300	240	1,680	300	1	Cylindrical, 6-ft. diameter, 6-ft. wide	1	a.c. motor, d.r. gear	3 phase, 2,200–500 volts, 50 cycles	3 phase	....
Gwaun Cau Gurwen, Swansea	1,140	1,500	6,720	1,800	2	Cylindrical, 11-ft. diameter	1 1/16	d.c. motor, direct-coupled	3 phase, 3,000 volts, 50 cycles	Ilgner	1913
General Mining & Finance Co., Johannesburg	2,890	1,470	12,000	3,300	1 skip	Conical, 10-ft. to 17-ft. 6-in. diameter	1⅜	d.c. motor, direct-coupled	3 phase, 6,000 volts, 50 cycles	Ward Leonard	1911
Brakpan Mines, South Africa	3,800	.....	10,000	3,500	....	Cylindrical, 10-ft. diameter	..	.....	3 phase, 2,100 volts, 50 cycles	Ward Leonard	....
Dam & Motor, Rhodesia	1,500	.....	600	1,440	....	2 conical drums	..	.....	.....	Ward Leonard	....

types of auto slip regulator, (1) the contactor type, and (2) the liquid type.

The contactor type is sensitive and rapid in action but of high cost. The liquid type is more commonly used. In it, the controller is of the moving electrode type with moving electrodes coupled to a small torque motor placed on top of the tanks. The torque motor is connected to the stator of the induction motor so that when the load varies a predetermined limit the torque motor operates and lowers the movable electrodes.

The rate of acceleration and retardation is governed by the movement of the face-plate, which is controlled by cam wheels driven by reduction gears from the drum shaft or from the depth indicator. By setting the cams the quadrant through which the face plate can be turned by the driver is controlled, or the lever will be forced back automatically in his hands if he does not retard at certain predetermined places.

Advantages of Ward-Leonard Control

For ease, accurate control, high speed, and dynamic electrical braking the Ward-Leonard control system is unequaled. No speed limits are imposed on the hoist except what is considered safe for the condition of the shaft. All braking being electrical, the mechanical brakes act only as locking devices at the end of the trip. With this control every position of the control lever is equivalent to voltage supplied the armature and directly proportional to the speed of hoisting. The power dissipated in other systems in the starting resistances is thereby saved.

When the power system is large and the cost of power low, the Ilgner system is not recommended in addition unless the peaks make the power system objectionable for other uses. If the power system can stand a peak of not over five seconds' duration it does not pay to add the flywheel, as the acceleration load is triangular, coming on so gradually that there is no disturbance on the line. The peak load comes on gradually and is slightly greater than the peak of the a.c. motor and is short, while the peak of the a.c. motor comes on immediately and lasts through the entire period of acceleration.

Disadvantages of Ward-Leonard Control

The chief disadvantage of the Ward-Leonard system is its initial cost. Extra initial cost is not justified by reduced consumption of power due to elimination of rheostat losses. The Ilgner system costs 30 to 35 per cent more than Ward-Leonard and the freight is considerably higher. When the flywheel is used there are constant losses in friction and windage.

Though the cutting down of the peak loads may appear economical, one must remember that the efficiency of the Ward-Leonard and Ilgner systems is much lower than that of the straight induction motor. The efficiency of the Ilgner system is 10 to 12 per cent less than that of the Ward-Leonard.

Where rope speeds are low there is nothing to be gained in using this system. If the hoisting is intermittent, the constant motor-generator and flywheel losses will often offset all its advantages.

It is advisable to equip the hoist with all safety appliances, more especially when the machinery is operated by native labor. The essential safety appliances are as follows:

1. An overload and no-volt release on the main line which cuts off the power, or on loss of power, in conjunction with other apparatus, applies the brakes.

2. A brake solenoid. This is a brake operated by a heavy weight. As long as the current is not interrupted the brake is held off by the current, but in the event of the current being shut off the weight falls and applies the brake.

3. Limit switches. These are generally contact switches placed in the headgear to prevent overwind. Their action is to cut off the power from the solenoid, which automatically applies all the brakes. The switches are exposed to the rain and snow, and unless carefully looked after may not act. Consequently a more suitable one is attached to the depth indicator. The pillar type of indicator with the screw spindle lends itself to this arrangement very satisfactorily and has an additional factor in that if the cage is moved in the wrong direction it will cut the power off again.

4. An overspeeding device. This is generally of the centrifugal type and driven from the motor or drum shaft. It can be set for any desired speed, which, if exceeded, breaks the circuit and applies all the brakes automatically.

5. The driver's emergency switch, to close the circuit when it is broken for any cause. The Ward-Leonard system is especially adapted for all safety appliances and has wonderful control. By a system of rods and cams connecting the driver's lever and the depth indicator, the control at certain periods and places in the shaft is taken out of the driver's hands. For instance, in starting, he can only accelerate at a predetermined set rate and must retard when approaching the collar. At certain places in the shaft, for instance at an underground skip dump, the cams can be set so that the skip will proceed into the dump at slow speed. The cam actually forces the lever back in the driver's hands and allows the skip to be moved at a certain safe speed.

6. Acceleration and retardation are generally at the same rate, and the shorter the better, provided the peak is not unreasonable or objectionable. This gives a longer period for full speed, which is more efficient. Most motors are made to stand a double load for these short periods. However, very little is gained by cutting down the acceleration or retarding period to less than ten or twelve seconds. When less than this, the high peak and low motor efficiency and rheostatic losses are objectionable. Torque for acceleration should not exceed two and one-half times full-speed torque.

7. Appliances to keep decking time at a minimum and allow a longer time for actual hoisting are essential, inasmuch as much time is wasted in this operation.

Brakes

Brakes used on hoisting engines are of two types: band and post brakes.

The band brake is a flexible steel band around the brake path lined with wood. It is good only for light loads, as on heavier duty the band would have to be made too thick to be flexible.

Post brakes are of two types. In one, the posts are anchored below the drum with tension rods on top operated by a bell crank lever. With this type the friction is greater at the bottom than at the top and causes unequal wear on the blocks. This type is used on the smaller hoists up to 5 ft. in diameter.

In the other type the posts are generally straight,

with a block to fit the circumference of drum brake path. For larger drums and heavier duty, a better and more expensive modification of this type is used. The brakes are of the caliper type, anchored below the center of the drum, the brake almost enveloping the entire circumference of the brake path. The power is applied through tension rods and bell crank lever. This brake is quite satisfactory, but still there is not uniform pressure along the entire brake surface controlling the drum.

For the largest hoists, the best brake is the suspended or aërial-post type. In this type the posts, which are of the caliper type, are suspened by brackets near the center and the tension rods are at each end, giving a parallel motion and equal wear to the brakes. No cast iron should be used; the posts should be of the box girder type. Pressure on the blocks should not exceed 50 lb. per square inch on Ferodo and 35 lb. on wood blocks. To equalize the strain on the drum there should be a brake path on each side.

When the force exerted on the brake lever exceeds 100 lb. with 15-in. travel, foot power and handwheel are insufficient and a dead weight is substituted and released by power. This power is generally air or oil.

Hoists manufactured in Great Britain have brakes operated by air engines. This consists of an air cylinder with a tandem oil or cataract cylinder above. Air entering the air cylinder lifts the dead weight, and the oil in the cataract cylinder, with a by-pass connecting both ends of the cylinder, regulates the speed at which the brakes can be applied. This requires a small compressor in addition to the brake engines. Air can also be admitted to the top of the cylinder to augment the pressure, but this generally means lightening the dead weight and is not recommended, as in the case of failure of air the dead weight is not sufficient to give adequate braking power.

In the United States oil is generally used in hydraulic cylinders on much the same principle as air. Here the oil is maintained at a pressure in an accumulator tank by a motor-driven pump. The oil is admitted and released from the cylinders by small valves controlled by a brake lever.

Oil, although not more reliable, is simpler, since it requires no cataract cylinder as in the air-brake engine, and requires less power in driving the pump than does the compressor. Fewer repairs are required by a pump working in oil than by the compressor. At the same time it becomes part of the forced-lubrication system, supplying oil to the bearing gear case and the flywheel from the accumulator tank.

Clutches

When hoisting from one level, one drum is often keyed to the shaft and the other allowed to run loose on a brass bushing and operated by a clutch. This reduces the number of levers in certain types of hoists and also the number of friction clutches, and makes a cheaper installation. This type can also be used for hoisting from different levels, but all the manipulation for decking cages has to be done on one drum and much valuable time is lost. Again, when jaw or multi-tooth clutches are used there is an additional advantage with both drums loose, as a closer adjustment of the rope can be made on decking cages simultaneously on different levels. With the present safety appliances on electric hoists the type having both drums loose is generally considered as safe as the other.

The jaw-type clutch is the simplest, safest, and cheapest. However, the drum must be at rest or nearly so to clutch in. It is not good for hoisting from different levels.

The multi-tooth clutch is used mostly on hoists manufactured in Great Britain. As the drum increases in size the error in the rope varies in inverse ratios as the jaws in the clutch. Therefore drums over 6 ft. in diameter are equipped with multi-tooth clutches. The larger the diameter of the clutch and the number of teeth with reference to the diameter of the drum, the smaller will be rope error. The teeth are made strong enough so that one in contact will support the load.

With a 30-ft. drum and a 10-ft. clutch, where each individual tooth is made strong enough to sustain the load, the error is 24 in. This can be diminished if both drums are loose, but still is not satisfactory if much hoisting is done from different levels.

The axial friction type of clutch is most commonly used in the United States. This consists of heavy ribbed annular rings faced with wood, supported on spider arms keyed to the shaft. Although possibly not so safe as the multi-tooth clutch, it is more efficient and economical and is adapted to hoisting from different levels. The clutch is applied and released by double-acting cylinders, either air or oil, preferably oil. Clutches should be so interlocked with the brake gear that the clutch cannot be taken out without automatically applying the brakes.

Cages

Cages should be as rigid and as light as possible, since they form part of the dead load. They should therefore be made of high-grade material. The width and length is fixed by the size of the hoisting compartment, and the height, if the cage is to be used for timber and supplies, by the length of the largest size of timber to be stood upright, not considering special long pieces that can be handled by opening the bonnet or underslinging beneath the cage.

The weight of cage will depend on the load that it is required to carry. The inside clearance should not be less than 6 ft. 6 in. when used for hoisting men and supplies and in many cases 10 ft. is far more advantageous. Large cages which will take a loaded timber truck from the surface timber yard to the various levels in the mine without additional handling are a decided advantage.

Generally a factor of safety of 10 is allowed when calculating the strength of the cage. The size and weight, including the load, of single-deck cages are given in the accompanying table.

Weight of Single-Deck Cages

Size, Ft.	Weight, Pounds	Car, Pounds	Contents, Pounds	Total Load in Cage, Pounds
4x 3	2,000 to 4,000	1,000	2,200	3,200 to 6,000
4x 3	5,000	2,500	6,500	9,000
4x 5	900 to 1,400	.....	.....	2,000
4x 5	1,400 to 1,800	.....	.....	3,000
4x 5	2,800 to 3,000	.....	.....	4,000
4x 8	4,700 to 6,000	.....	.....	9,000
6x11½	5,600	2,500	6,000	8,500

Weight of Two-Deck Cages

Weight Top Deck, Pounds	Weight Lower Deck, Pounds	Load per Car, Pounds
3,600	2,000	2,500
2,600	2,000	2,500
2,400	960	2,500

If there is considerable handling of cars, landing chairs at each level are necessary. In small mines landing chairs attached to the cage are used to avoid the expense of installing chairs on every level. This may be justified in small plants, but seldom in a large mine, because they are objectionable on account of the extra dead weight and the danger of their coming into action during fast hoisting. Properly designed landing chairs are kept sufficiently clear of the cage by a weight. To place the chairs under the cage a lever has to be pusned forward, which raises the balance weight, until the cage rests on the chairs. As soon as the cage is raised the balance weight throws the chairs back out of action.

In mines where coolies are employed it is advisable that the brake lever consists of a socket and handle. The cage attendant inserts the handle into the socket to operate the lever and can take it out to prevent anyone tampering with the chairs.

SKIPS

In hoisting one class of ore from deep and narrow shafts skips are generally more satisfactory than cages, as they take less time for loading and dumping. There are many good types to choose, the essential consideration being that the length should not exceed twice the least cross-section dimension, as anything over this makes slower dumping and also causes the damp ore to stick and pack in the skip and so not be dumped, thus cutting down the capacity of the skip. Capacities vary from a few tons to twelve tons. The size of plate will vary from $\frac{1}{4}$ to $\frac{1}{2}$ in. for side plate and $\frac{3}{8}$ to $\frac{3}{4}$ in. for front and bottom in largest.

The combined skip and cage lends itself to both hoisting by car and skip and is extremely useful in handling supplies, men, and smaller tonnage of various classes of ore.

In shafts in which hoisting is done from a lower level to an upper adit level by skip, certain complications are involved in the dumping arrangement. The lower curved slot-like track which leads the skip into the dumping position must be movable to let the skip and cage be raised to the collar of the shaft without the skip going into the dump. This is a source of danger, and the small track should be moved by a motor under the direct control of the hoist engineer, and the cam arrangement on hoist control so arranged that travel through this dump will be at reduced speed.

Speed of hoisting in shallow shafts is generally 600 to 1,000 ft. per minute for ore and 600 ft. for men. Acceleration of 3 to 4 ft. per second for depths of 200 ft. is preferable. The law of Montana limits the speed to 800 ft. per minute for men and 2,000 ft. per minute for ore. Speeds of more than 4,000 ft. per minute are seldom practicable, and depend on depth of shaft. Acceleration of 5.8 ft. per second is high; 13.5 is extraordinarily high (to meet certain conditions). Retardation should be at such a rate that there will be no external braking.

One of the largest hoisting engines in the world is being built by Metropolitan Vickers for Crown Mines, Johannesburg, South Africa. It is to have a cylindro-conical drum 15 ft. to 30 ft. inside diameter driven at 37.2 r.p.m. (full speed) by two direct-coupled motors

Capacity and Weight of Skips

Capacity Cubic Feet		Pounds
60	United Verde	3,950
80	United Verde	4,800
100	United Verde	5,800
112	United Verde	12,000
160	United Verde	8,000
Pounds		
12,200	New Jersey Zinc Co	5,500
10,000	Boston & Montana	7,200
13,440	Newport Mining Co	4,500
22,000	(Skip plus yoke) New Orleans	15,100

Capacity and Weight of Combined Skip and Cage

	Capacity Skip, Pounds	Weight Skip, Pounds	Weight Cage, Pounds
Butte Mines	4,000	3,050	1,550
Butte Mines	6,000	4,000	1,000
Butte Mines	8,000	5,880	3,000
Butte Mines	12,000	6,500	3,300
Butte Mines	12,000	8,700	3,900
Butte Mines	12,000	9,000	3,500
Butte Mines	14,000	14,000	3,600
North Butte Mining Co	14,000	8,000	1,800

Hoisting Speeds at Various Mines

	Depth, Feet	Maximum Speed, Feet per Minute	Acceleration, Feet per Second	Distance to Reach Maximum Speed, Feet	Time to Reach Maximum Speed, Seconds	Loading, Seconds	Complete Hoist
New Jersey Zinc Co	1,610	3,000	3.33	375	15	5	35 to 50
International Nickel Co	1,600	1,100	2.33	260	15	..	....
Witherbee, Sherman & Co	1,000	1,200	1.33	150	15	..	....
Copper Range	1,500	2,360	2.48	130	10	..	....
Sulphide Corporation	825	3,650	5.06	300	15	..	....
United Verde	850	2,000	4.7	115	10	..	....
United Verde	1,700	1,000	....	...	10	..	....
Great Boulder	2,000	2,000	5.83	95	6	..	....
Boston & Montana	3,500	3,500	....	...	..	8	....
Newport Mining Co	2,700	3,000	....	...	..	5	60
Harworth Main Colliery, Yorkshire, England	3,000	3,170	....	232	15.6	10	89.2
New Orient, Illinois	607	4,000	13.5	...	5	9	26

Motor Specifications of Electric Hoists

Motor			Supply		Duty				
R.M.S.	Maximum B.H.P.	R.P.M.	Volts	Period	Depth of Shaft	Speed, Feet per Minute	Net Load	System	Names
1,500	3,700	33	3,000	25	4,500	2,200	16,000	Ward Leonard	East Rand Proprietary Mines, South Africa
1,850	.....	71	550	60	4,000	3,000	14,000	Ilgner	North Butte Mining Co., Montana
1,530	3,000	96	2,100	50	3,800	3,500	10,000	Ward Leonard	Brakpan Mines, Ltd., South Africa
875	2,000	292	2,000	50	4,500	2,000	14,000	Geared A.C.	Robinson Deep, Ltd., South Africa
600	1,000	60	2,100	50	3,000	2,000	6,000	Ward Leonard	West Rand Consolidated Mine Co., Ltd., S. A.
670	1,000	360	2,100	50	3,000	2,000	8,000	Geared A.C.	Witwatersrand Deep, Ltd., South Africa
550	875	365	3,300	50	1,450	2,460	2,912	Geared A.C.	Bengal Coal Co., India
350	600	360	2,000	50	2,200	1,600	3,600	Ward Leonard	Randfontein Central G. M. Co., South Africa
400	581	277	2,200	50	494	1,020	8,800	Geared A.C.	Tharsis Sulphur & Copper Co., Spain
275	425	230	550	50	1,500	1,440	6,000	Ward Leonard	Cam & Motor Mines, South Africa
2,400	3,850	350	500	D.C.	3,000	3,150	16,800	Stubbs Perry..	Harworth Main Colliery, England
2,200	.....	575	2,200	60	607	4,000	22,000	Ilgner	New Orient Mine, Illinois
700	.....	695	....	..	1,700	1,000	1,600	Ilgner	United Verde, Arizona

having a normal peak rating of 5,930 hp. and a maximum peak of 8,000 hp.

The New Orient hoist is driven by two 2,000-hp. direct-coupled d.c. motors.

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Alumina Made from Bauxite in Electric Furnace by Haglund Process

The Haglund process of making alumina, Al_2O_3, electrothermically from bauxite in an electric furnace was referred to in an editorial in the *Engineering and Mining Journal-Press* of April 10, 1926. A description of this process was published in *Industrial and Engineering Chemistry* for January, 1926, from the pen of Ture Robert Haglund himself. Mr. Haglund says that the analysis of the aluminum oxide made by the process is even better than that of the oxide obtained in the usual chemical process and used for the electrolysis in one of the biggest aluminum works in Europe. It has also been found that this crystallized aluminum oxide, when electrolyzed in the usual way, gives pure and sound metal, without any difficulty during treatment in the electrolytic bath.

The building costs for a plant using this process are much lower than those for a plant using any of the chemical processes, according to Mr. Haglund. One of the big European aluminum companies has estimated that for a new chemical alumina plant the building costs are about $5,000,000, whereas for a new plant, which they have decided to build for the Haglund process, the maximum estimate is $1,250,000, both figures being calculated on an output of about 25,000 tons of aluminum oxide per annum. This difference in the building costs means a saving of at least $15 per ton of aluminum oxide for interest and amortization.

Another important advantage of the process over the Bayer or other chemical processes, according to Mr. Haglund, is that even bauxites so high in iron and silica that they could not be used in the chemical processes will give a pure aluminum oxide when treated according to the Haglund method. Moreover, even the economy of the process is hardly dependent upon the quality of the bauxite, because the iron oxide and silica present are reduced and transformed into easily salable high-silicon pig iron.

In describing the process Mr. Haglund says:

"The impurities of the bauxite, iron oxide, silica, etc., are reduced with carbon in the furnace, which is run continuously. The most important new feature is that the resulting aluminum oxide slag contains a certain amount, about 15 to 25 per cent, of a sulphide, preferably aluminum sulphide, which, at the temperature prevailing in the furnace, dissolves the aluminum oxide. Through this agent the melting temperature of the slag is considerably lowered. (The melting point of aluminum sulphide is about 1,100 deg. C., and of aluminum oxide about 2,200 deg. C.)

"The sulphide-oxide slag is very fluid and therefore easy to tap, and separates easily and completely from the resulting alloy. As an additional advantage, the aluminum oxide in the sulphide-oxide slag crystallizes when the slag is solidifying. The sulphide may be separated from the oxide crystals by a very simple operation.

"The aluminum sulphide may be manufactured by a separate operation and then charged together with the other raw materials, but it has proved advantageous to arrange the process so that it is formed in the process itself. Bauxite, carbon (coke or charcoal), and pyrrhotite (magnetic pyrite), or some other sulphide of a heavy metal are treated in an electric furnace. Aluminum sulphide is formed according to the following equation:

$$Al_2O_3 + 3C + 3FeS = Al_2S_3 + 3CO + 3Fe$$

"It is assumed that aluminum is first reduced as metal and immediately reacts with ferrous sulphide forming aluminum sulphide. Twenty per cent of aluminum sulphide in the sulphide-oxide slag is sufficient for obtaining a pure aluminum oxide. In addition to the carbon needed for the reduction of the impurities of the bauxite, therefore, enough carbon has to be added for the foregoing reaction, which results in the formation of about 20 per cent aluminum sulphide. Further, enough pyrrhotite, or other sulphide of a heavy metal, has to be added to transform the reduced aluminum into aluminum sulphide.

"If the bauxite is high in iron it has proved advantageous to treat it with hydrogen sulphide obtained by the decomposition of the aluminum sulphide-oxide slag. This treatment may be combined with a calcining of the bauxite. Through this sulphurizing of the bauxite the consumption of pyrrhotite in most cases will be reduced to one-third and the consumption of electric power will be reduced to about 75 per cent. Besides the aluminum sulphide oxide slag, a rather considerable quantity of pig iron containing all the silicon of the raw material is obtained. This iron separates readily at the tapping of the furnace from the sulphide-oxide slag. The iron is very low in sulphur because of the high temperature in the furnace and of the greater affinity of the aluminum to sulphur.

"By regulating the rapidity of the cooling of the slag, crystals of different sizes can be obtained, which is important when manufacturing alumina for abrasive purposes.

"After cooling, the slag is crushed and treated with water in a suitable apparatus operating continuously. Hereby the slag is decomposed according to the equation:

$$Al_2S_3 + 6H_2O = 2Al(OH)_3 + 3H_2S$$

"The hydrogen sulphide is carried off and used for sulphurizing the bauxite or for the manufacture of sulphur in a Claus furnace. A mixture of crystallized oxide and aluminum hydroxide mechanically mixed with smaller quantities of iron sulphide, titanium sulphide, etc., remains. This mixture is treated on classifiers, concentrating tables, and other dressing apparatus. The products are pure, crystallized aluminum oxide, aluminum hydroxide mixed with a small percentage of crystallized aluminum oxide, and finally impurities consisting mainly of undecomposed sulphides and iron pebbles. The crystallized aluminum oxide is washed with warm sulphuric acid and finally dried. The aluminum hydroxide can be calcined and circulated in this process or used for the manufacture of pure alumina or aluminum salts, or for cement fondu.

"Experiments on a non-commercial scale have proved that anhydrous aluminum chloride can be produced direct from the aluminum sulphide in the sulphide-oxide slag without any difficulty in the separation and washing of the crystallized aluminum oxide. This possibility is important commercially, as an inexpensive anhydrous aluminum chloride is of great interest as a means of cracking crude oil."

Estimation of Ore in Copper Mines

Careful Sampling and Check Assays Necessary—Plant Equipment and Ore Reserves Should Be Properly Balanced

By Albert A. Leach
Mining Geologist, Tyrone, N. Y.

IMPORTANT to all concerned in management or operation, is trustworthy information of the amount of ore in a mine. This discussion applies particularly to the porphyry copper mines of the Southwest, but some of the material herewith presented is of wide application. The viewpoint is that of the operating owner, who is neither as over-cautious as the buyer nor as over-optimistic as the seller. As owner of the property his problem is to make the greatest possible return from its operation.

The sampling and estimation of ore has become fairly well standardized. Under a progressive management, the work of sampling, of keeping the sample records, and of planning development and prospecting is supervised by a competent geologist. In general, three sets of level maps are made: one for geology, one for face samples, and one for channel samples. All underground advance should be sampled every five or ten feet, regardless of how low the material may assay. These samples are taken with a prospect pick across the face, or sometimes by grabbing the muck pile. They weigh from four to six pounds and are usually assayed by the cyanide method. Individual results vary considerably, but when taken by a carefully trained sampler, averages will check channeling rather closely. These samples are plotted on the face-sample maps.

From the information thus obtained all workings in material of 0.5 per cent copper or better grade are channel sampled. These are cut-groove samples, carefully taken, spaced at five-foot intervals, and weighing about forty pounds each. They are assayed by the electrolytic or iodide method. These results are plotted separately on the channel maps. All the maps are usually made on tracing cloth, on a scale of 50 ft. to one inch, of a convenient size, about 2½x3½ ft. being usual dimensions.

To take care of the vertical work, loose-leaf raise books are kept, the samples being plotted to scale and carefully indexed. For orebodies, a series of vertical sections is made on the stope interval (the distance between chutes), and on these the drifts and raises are plotted, with each assay shown in its proper position. On these, the outlines of the orebody are drawn. The transparency of the tracing cloth aids in the visualization of the larger limits of the whole, and the adjoining sections influence the drawing of the ore boundaries on each. Incidentally, it is remarkable how these sections point out, almost automatically, the requisite development and prospecting work. The veriest tyro, by their use, can direct the development work more efficiently than the most active superintendent, industriously trotting about the mine.

Once the outlines on the sections are drawn, the estimation of tonnage and grade is reduced to the mechanical detail of obtaining the area of the ore on each section, usually by the planimeter, averaging all the samples thereon, finding the general average, properly weighted by areas, multiplying by the distance between sections, and dividing by the number of cubic feet to the ton in place.

Churn Drill Suitable for Sampling Large Areas

The churn drill is the most suitable means of prospecting large virgin areas. Its principal advantages are:

1. It permits of flexibility and boldness in prospecting.
2. The cost per foot is only about one-quarter of that of mine openings.
3. Properly taken samples are entirely reliable.
4. Even in the absence of ore, it gives valuable information as to the elevation of the enriched horizons.

When sufficient churn-drill information is available it may be plotted on vertical sections and used as described for underground workings. In this case the sections are apt to be fewer and at longer intervals, and the use of the prismoidal formula in calculating tonnage may be justified.

Determine Minimum Grade That Can Be Worked

As a basis for the ore estimate, it is customary to determine the grade of ore which yields neither profit nor loss under the existing or assumed conditions. This figure is increased to yield a certain desired profit, and is then used as the minimum grade allowed in drawing the ore boundaries. The calculations previously described then yield a result of so many tons of a certain grade, which is accepted as completely representing the resources of the ore deposit. This is only a partial truth, and is always misleading. The adoption of a lower minimum grade results in a larger tonnage of lower-grade ore. The fact is that there is a variable relation, the tonnage increasing as the grade decreases. The proper way to present this variable relation is by a curve. This curve is derived by making several estimates with different minima, and plotting the several results on co-ordinates of tonnage and grade of ore.

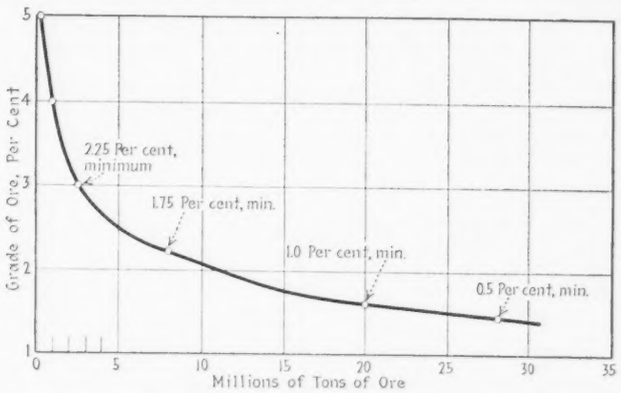

Fig. 1—Curve showing increased tonnage of ore as grade is lowered

Such a curve is shown in Fig. 1. In Fig. 1, when using a minimum of 2.25 per cent there is 2,500,000 tons of ore having an average grade of 3 per cent. When the minimum is reduced to 0.5 per cent, the tonnage is increased to 28,000,000 having an average grade of 1.40 per cent copper. This curve, though it is a generalization, is based on actual occurrences, and cannot be dismissed as merely theoretical. The form of curve will vary for each individual deposit, but the general type for large copper deposits will probably closely approximate that shown in Fig. 1. It should be realized that this curve is merely a graphic presentation of the actual relations found by experience to exist in a certain orebody.

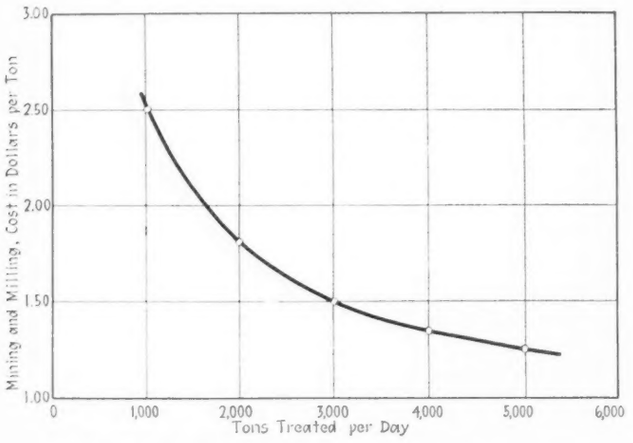

Fig. 2—Curve cost reduction as tonnage increases

Another curve, as illustrated in Fig. 2, may be constructed to portray the varying relations between unit costs and the scale of operation. The decrease in cost per ton as the daily tonnage increases is due not only to the lowering of the unit cost that nearly always occurs on increasing production but also, and probably to a greater extent, to the fact that the orebodies are so enlarged that different and cheaper methods of mining become permissible.

Plant Equipment and Ore Reserves Should Be Balanced

It is obviously absurd to place a large plant on a small orebody. If we assume that, for proper balance, the operation should have a life of approximately fifteen years, we may substitute for tons per day in Fig. 2 the total tons of ore reserve, as in Table I.

Table I—Capacity vs. Reserves

Tons per Day		Tons of Reserve
1,000	Requires	5,000,000
2,000		10,000,000
3,000		15,000,000
4,000		20,000,000
5,000		25,000,000

By using the corresponding grades for the respective tonnage reserves from Fig. 1, the pounds of copper per ton are obtained, as in Table II.

Table II—Reserves vs. Grade

Reserves, Tons	Grade of Ore, Per Cent	Pounds of Copper, per Ton
5,000,000	2.5	50
10,000,000	2.1	42
15,000,000	1.8	36
20,000,000	1.6	32
25,000,000	1.45	29

These figures are reassembled to give the operating cost per pound of copper mined for the various estimates, as is shown below in Table III, "Reserves vs. Cost."

Table III—Reserves vs. Cost

Reserves, Tons	Pounds of Copper, per Ton	Cost	
		Per Ton	Per Pound of Copper, Cents
5,000,000	50	$2.50	5.0
10,000,000	42	1.80	4.28
15,000,000	36	1.50	4.17
20,000,000	32	1.35	4.22
25,000,000	29	1.25	4.31

Table III shows that, for the case presented, the cost per pound is practically constant between limits of 10,000,000 tons of 2.1 per cent and 25,000,000 tons of 1.45 per cent ore, and rises for a lesser amount of higher-grade ore. Since the cost is constant, the future price of copper has no effect on the optimum ore boundaries. The costs in Table III are not the final total costs, which would increase as the recovery decreases. The percentage of recovery is, in general, independent of rate of output. Other charges would further increase the cost, but for the most part these are constant when referred to the pound of copper, and the figures used represent the effect of the variables under control. Obviously, the maximum profit is to be obtained by treating the larger amount of lower-grade ore, as the cost, and therefore the profit, is constant to the lower limit taken. The effect of still lower minima should be investigated, in order to be assured of the most profitable type of operation.

It is quite possible that in another case this method would indicate a decidedly lower cost per pound at some intermediate grade. In this event it is necessary to assume the future price of copper, as it may be that a smaller profit per pound on the greater number of pounds furnished by lower-grade ore will yield a larger final profit than that from ore yielding the highest profit per pound. The future price of copper is a matter of conservative judgment.

This method of analysis is of great value in gaging the possibilities of an ore deposit, and well worth the effort expended.

Alluvial Diamond Production in Transvaal Shows Large Increase

The following figures, showing the output and value of the Transvaal alluvial diamond diggings, were compiled by Alf. Hellowell and published in *The Star* recently:

Alluvial Diamond Production 1909 to 1926

	Total Carats	Gross Value	Average Value per Carat £ s. d.
1909	1,450	£6,990	4 16 3
1910	783	2,887	3 13 7
1911	26,736	124,306	5 0 4
1912	81,635	384,881	4 14 3
1913	81,905	405,876	4 19 1
1914	37,817	141,699	3 14 11
1915	33,502	126,416	3 15 5
1916	45,758	242,213	5 5 9
1917	65,447	400,118	6 2 2
1918	57,926	406,304	7 0 3
1919	74,943	1,042,661	13 18 3
1920	94,606	1,099,746	11 12 6
1921	65,830	401,003	6 1 9
1922	93,627	658,128	7 0 7
1923	123,986	845,325	6 17 2
1924	147,159	1,082,183	7 7 0
1925	127,121	991,392	7 16 0
1926*	115,469	789,082	6 17 6
Total	1,275,900	£9,181,210	

*Six months ending June 30.

Discussion

J. B. Tyrrell and the Beaver Auxiliary

THE EDITOR:

Sir—On page 470 of your journal of Sept. 18, your correspondent for northern Ontario refers to the affairs of the Beaver Consolidated Mines Ltd., in which he says "The Beaver directors, before deciding to spend more money on the (Beaver Auxiliary) property, had a report made by Mr. Tyrrell. . . . The directors apparently considered the report favorable as they decided to spend the money on the property and this money had to be raised by the sale of Kirkland Lake Gold Shares."

For the sake of accuracy, and to avoid any future misunderstanding among the Beaver shareholders who might be misled by the statement quoted above made in a paper of the high standing of the *Engineering and Mining Journal*, it is only right to state that I made two short reports a month apart on the Beaver Auxiliary property, a silver prospect near Elk Lake, the first after a very brief visit to the property and the second after a longer visit. Mr. Burrows, the Provincial Geologist of Ontario, had recently published the statement that the rich silver-bearing veins in the adjoining Gowganda district were either in the upper portion of the sill of Nipissing diabase, or in the conglomerate *overlying* it, rather than in the lower parts of the sill or in the rocks *underlying* it. A large amount of mining work had already been done on the Elk Lake property by the Beaver Consolidated Mining Co. However the property had been lying idle for about ten years, and my examination was made to determine what relationship the small vein or veins known to occur on it bore to the diabase sill or to the overlying or underlying rock, and if in the diabase sill, whether they occurred in the top, middle, or bottom of it.

As the result of my examination I arrived at the same conclusion as Mr. Burrows as to the position of the silver-bearing veins, which were here small and unimportant. That was more than a year ago, and since then I have had nothing to do with the operations on the Beaver Auxiliary property, but as Vice-President and Managing Director of the Kirkland Lake Gold Mining Co., whose property had been improving every day under development, and in which the Beaver company has a very large interest, I have consistently opposed the selling of large blocks of its stock to finance Beaver Auxiliary.

J. B. TYRRELL.

Toronto.

Cutting Steel With Illuminating Gas

THE EDITOR:

Sir—In the *Engineering and Mining Journal* of Aug. 21, page 304, Mr. E. E. Thum, of the Oxweld Acetylene Co., makes observation that "city gas torches for cutting steel are not new."

Dentists, jewelers and laboratories have used Bunsen burners and blow pipes for many years. The writer in 1918, while in charge of efficiencies and research in one of the biggest shipyards on the Pacific Coast, at a time when acetylene demand might have been greater than the supply, laid five miles of gas mains and pipe lines inside the shipyard, along drydocks and marine railways, for the purpose of using city gas with the oxygen torch for steel cutting, pipe bending, and the like. In the boiler shop, where Scotch marine boilers were being constructed, in the plate shop, in the angle yard and on repair work, all work with the torches (except welding) was done with city gas. Controversy arose then, as now, by those who were interested in the production and sale of acetylene and carbide as to the efficiency of the city-gas torch, the speed of the cutting and the quantity of oxygen required, and competitive tests were arranged and experts were brought from the factories by interested parties to demonstrate in comparison with the city gas.

Owing to the limited space available, it is sufficient to comment here that the city gas met the competition satisfactorily and that it effected a saving of acetylene cost of over $300 a day, with city gas at 70c. per 1,000 cu.ft. and acetylene at $27 per 1,000 cu.ft. There are other factors of saving outside of acetyene cost but that is the subject of another article.

Mr. Thum's observations are well emphasized and explain well-known theories and well-tried experiments with other gases than acetylene, to all of which there will probably be no debate. His closing paragraph begins: "All of the above is based upon the assumption that the illuminating gas available is of very high quality." To this statement I inquire just what he means by "high quality." Does he mean high in B.t.u. value, high in flame heat value, or does he refer to some thermo-chemical relation of carbon and hydrogen with oxygen. Permit me to remark that practically all manufactured city gas in the United States carries from 500 to 600 B.t.u. per cubic foot at 760 m.m. pressure, giving the computed flame heats above 4,000 deg. Natural gas has from 900 to 1,000 B.t.u. per cubic foot and will give a flame heat from 4,500 deg. to 5,300 deg. F., while any of the common gases, including coke-oven gas, water gas, producer gas, pintsch gas, etc., will furnish heat enough to make the steel red hot or far above 1,400 deg. F., at which temperature steel will burn readily in an atmosphere of pure oxygen. Any of these gases will furnish heat enough to melt steel, iron, gold, silver or platinum when burned with pure oxygen. Illustrations of this heat can be observed in any dentist or jeweler's laboratory.

The matter of obtaining gas fuel is becoming simplified. Almost every little city has its gas works. Cook stoves, gas heaters and gas furnaces are common. The problem of using city gas is not hinged upon the undefined term "quality," but is hinged upon the question of pressure available, amount of work to be done that would justify the equipment for the pressures.

Commonly, city gas is served at pressures of only a few inches of water column. Customers along routes of high pressure "feeder mains" may be able to obtain gas at pressures of from 5 to 25 lb. In machine shops

and steel plants it is well to have gas pressures around 35 or 40 lb., controlled to lower pressures either through a master regulator or through regulations for various kinds of work.

I have only to remind the readers that every garage and service station today has a small air compressor and receiver which automatically holds up pressure of 125 to 150 lb. of air for the purpose of filling automobile tires. These little compressors are inexpensive and can be installed in any plant without much outlay. The intake can be connected to a city gas main off the low-pressure lines and thus gas pressure for use on the torches can be drawn from a receiver full of gas at any pressure desired. In fact, the pressure can be maintained high enough to throw the flame through the deepest kerf. The Pacific Gas & Electric Co., of San Francisco, installed one of these pumps in their demonstrating room in 1919 after I had put some 200 or more cutting, flanging and pipe-bending torches on the city gas throughout the entire shipyard. To the best of my information, this demonstrating plant is still in operating and the Pacific Gas & Electric Co. will demonstrate the cutting of steel with city gas at any time.

Even if the pressures are not obtainable and the work is not sufficient to justify the little compressor, there is no reason why city gas companies everywhere might not furnish city gas in cylinders similar to those used as containers for hydrogen and oxygen. Natural gas, pintsch gas, manufactured city gas or hydrogen, can thus be shipped to the most remote places. With hydrogen selling at $10 per 1,000 cu.ft. and dissolved acetylene selling at $25 to $30 per 1,000 cu.ft., it would seem that city gas companies, where structural steel work is going on, might derive a neat revenue from gas sold under pressure in cylinders. Pintsch gas is so carried on railroad trains and for use by bridge builders of the railroad company. Something like ten or more manufacturers of oxygen torches are already advertising them as capable of using other gases than acetylene, so it seems that the question of the fuel gas is only a matter of convenience and not of quality. With the oxygen the question of quality is of prime importance, both in steel cutting and in welding.

Tonopah, Nev. LETSON BALLIET.

Wherein Is the Lure of Mining?

THE EDITOR:

Sir—It is with much regret that I decline to renew my subscription to your valued *Engineering and Mining Journal.*

Inasmuch as the art of mining no longer controls my bread and butter supply nor regulates my activities I do not feel sufficiently interested in mining to continue reading the *Journal.* Almost four years of ladder climbing and transit packing experience has taught me that the business is not what popular fancy would have us believe it is. I learned that salaries, as a general rule, are extremely low, the office work is monotonous, and working hours are long, without reason.

If you can tell me why an engineer should work ten hours daily the year 'round, at a small salary, with no vacation, hence no hours of leisure to enjoy with his family, you will have answered a question that at one time caused me much concern. ARTHUR W. WINTERS.

Marquette, Mich.

Says Claim Holders Should Do Some Work

THE EDITOR:

Sir—In your Aug. 21, 1926, issue you publish an article, "All Greek," by Louis Keiper. I want to say I have been prospecting for thirty-seven years, starting as a snow melter, heating rocks and dropping them in a tub of snow to get panning water for my father.

We had no blue sky laws and very few dishonest prospectors. If a man asked for aid he had something he would bet more on than he would on four aces and a "45." I, for one, believe the blue sky law is the proper dope if it is imposed and handled right. How can any self-respecting prospector say that if one man in a hundred makes good, or one mine in one hundred makes good, the country and the people are better off? My checking up in thirty-seven years falls away short. I have made good money, and lost heavily. I have gone to grocer men with a hard-luck story and they have come back with one that made mine sound like prosperity. I have been in this county four years and all I have heard is men cussing the blue sky law and trying to hoodwink some one out of his money. California has the poorest mining laws in any state. People can hold ground and never do a tap on it for a lifetime; staking in northern California is out of the question; and it is nothing to see one man holding twenty-five to thirty mining claims; yet the district attorney will tell you that the man swore he did his work and you cannot or will not be heard.

Now, here is a party that located a stream of water in 1888. The district attorney tells that party to keep that water in his ditch and waste it—don't use it or let any one else use it as it is on the Forest Reserve. The law of this state reads that where agricultural ground appears on mineral land one can take up 160 acres as one claim by using eight names. There is a clause in the law which has been misinterpreted; I wrote to the Bureau of Mines about it and asked about the assessment work and they wrote me there was no limit to the amount of claims one man could hold, but did not say anything about assessment work. They also stated they knew of one man who held thirty-nine 160-acre claims of diatomaceous earth.

Now, what the prospector needs is a change of law, and he needs it badly. Let every man have all the ground he can handle and compel him to do $100 worth of work on every 20-acre block, or pay $5 per acre to a fund for bona fide prospectors to draw on. If you do that then you will see thousands of acres of ground turned loose. You will see hundreds of prospectors and a lot of good mines found.

All you prospectors that ever looked in a bean pot have been in districts where a few men held all the good claims and did nothing. Make them do something and we won't need any blue sky law in a mining venture.

Goodyear Bar, Calif. CLYDE E. TILFORD.

The Fault Was Not the Author's

THE EDITOR:

Sir—In my discussion of the Andean *salares,* which appeared in your issue of Sept. 11, the clause "by the collapse of a segment of the Andean *vault*" is printed "by the collapse of a segment of the Andean *fault,*" whereby the context becomes unintelligible.

San Francisco. ROBERT HAWXHURST, JR.

Greenawalt's Part in Development of Sintering Machine Ignition

THE EDITOR:

Sir—Referring to the article on "Coke-burning Ignition Stoves for Sintering Machines," by Robert Wallace, in your issue of Sept. 11, 1926, it seems to me that at least some credit is due to John E. Greenawalt for the general type of sintering ignition described, although he is not mentioned as having contributed anything to the art of sintering ignition.

The article refers to its use at the plant at Salida many years ago. The ignition device at Salida was in fact a modification of the reverberatory furnace, in which the flame and products of combustion, after impinging against the surface of the sinter charge, passed out through a stack. This same type of reverberatory ignition was used in Denver in 1904 to 1915, by John E. Greenawalt.

However, the ignition of the Greenawalt 1904 furnace, or of the furnace used at Salida, is not the ignition now generally used for either oil, gas, or solid fuel ignition, in sintering. In the ignition as now used there is no stack to take off excess flame or products of combustion, but the flame and products of combustion are sucked down through the sinter charge, without a stack. This method of ignition was invented by John E. Greenawalt in 1907, and first used on a large scale at the plant of the Modern Smelting & Refining Co., in Denver, in 1909 to 1910.

If a stack were placed over the reverberatory arch, as shown in the drawing in Mr. Wallace's article referred to, would the igniter function satisfactorily, if the stack also functioned? If it would, why not use the stack as it was used both in Greenawalt's 1904 furnace and later at the plant at Salida? Why was that method of ignition abandoned?

Denver. WILLIAM E. GREENAWALT.

The Homestead Act

THE EDITOR:

Sir—Enclosed please find $5 for which please continue my subscription for one year.

Please continue the fight on the damned Homestead Act on mineral land. Many politicians are trying to get an act through to legalize this robbery and kill the only real industry that we have, namely, mining. Legislators boast of the industries of New Mexico as agriculture and stock-raising, and condemn the mining industry as only a small item. But only a few years ago, when the mines closed and the miner bought no beef, a great howl went up and all was at a standstill until they opened up again. Legislators and politicians alike are short-minded animals and can only see the dollar of today. Kill the mines and you kill 80 per cent of the western states.

I cannot see why the mines should stand all the bumps of the day but such seems to be the case at present. Cattle and farm loans broke some of the best banks in New Mexico and still have a strangle hold on the finances of the state; that which was done to re-establish the banks in Grant County was done by men interested in, or men in, the mines, which does not include me, of course.

There still seems to be some question as to just who is who in the state mineral law. It has always been the case since I can remember that the Government held the mineral right to *all* mineral lands, whether state or homestead. Let us get this settled one way or another in the near future and try to help the mine just for once. Give the miner the show that has been given the stock man and I will bet my old hat that they will not break every bank in two or three counties. The miner has never asked much and has received much less.

Please improve discussion column; it is some stale lately. M. A. TRIMMER.

Hurley, New Mexico.

Consultation

A Bibliography on Flotation

"Can you refer me to the more important recent contributions to the literature of flotation?"

A list of articles appearing in the *Journal* and several other periodicals, government bulletins, books, and U. S. patents, and dealing with flotation is reproduced herewith in the belief that others besides the inquirer may find it valuable for their files, if not for immediate use.

Articles on Flotation from *Engineering and Mining Journal* Since Jan. 1, 1921:

Surface Energies in Flotation. Moses. pp. 5. Jan. 1, 1921.
Flotation Tests On Zinc Table Slime. Thornberry. pp. 2. Jan. 14, 1922.
Surface Tension Phenomena and Electrostatics. Jarvis and Leake. pp. 2. July 1, 1922.
Sodium Sulphide as a Differential Flotation Reagent. Parker. pp. 1. Oct. 7, 1922.
Flotation in the Slocan District, B. C. MacFadden. pp. 5. Oct. 14, 1922.
The Sundt-Diaz Flotation Machine. Sundt. pp. 1. Sept. 30, 1922.
Milling and Flotation. Taggart. pp. 4. Jan. 20, 1923.
New Concentrator of Asturiana de Minas, Spain. Diaz. pp. 6. March 3, 1923.
Recent Flotation Litigation. Rickard. pp. 3. Oct. 20, 1923.
Selective Flotation of a Complex Zinc-Lead Ore. Young. pp. 4. Sept. 15, 1923.
Selective Flotation at the Magistral-Ameca Plant. Payne. pp. 4. Dec. 29, 1923.
Milling and Flotation. Taggart. pp. 3. Jan. 19, 1924.
Electrometer Tests in Flotation. Bains. pp. 2. May 31, 1924.
A Basis for Selecting Flotation Reagents. Fredrick. pp. 2. July 5, 1924.
Selective Flotation at Nacozari. MacDonald. pp. 10. Sept. 20, 1924.
New Cornelia Concentrating Mill at Ajo, Ariz. Burch. pp. 16. Nov. 22, 1924.
Milling and Flotation. Locke. pp. 3. Jan. 17, 1925.
Floating and Leaching Copper-Molybdenum Ores. Doerner. pp. 2. June 6, 1925.
Development and Operation of a 50-Gram Flotation Machine. Gates and Jacobsen. pp. 2. May 9, 1925.
Oil-less Flotation of Minerals. Bains. pp. 2. Jan. 31, 1925.
Froth Flotation Explained by X-Ray. McLachlan. pp. 2. Sept. 12, 1925.
Differential Flotation of Copper and Iron Sulphides. Keyes. pp. 2. July 25, 1925.
Evolution of Copper-Ore Concentration at Morenci, Ariz. Crowfoot. pp. 7. Dec. 5, 1925.
Proper Use of Lime to Alkalize Mill Circuits. Henderson. pp. 1, Dec. 26, 1925.
A New Type of Flotation Machine. Forrester. pp. 1. Sept. 26, 1925.
Selective Flotation at Timber Butte. Robie. pp. 5. Oct. 31, 1925.
Flotation Practice at Morning Mill. Parsons. pp. 2. Sept. 12, 1925.
Milling and Flotation. Locke. pp. 3. Jan. 16, 1926.
Differential Flotation of Copper at Cananea. Tye. pp. 8. April 10, 1926.
Growth of Flotation in Tri-State District. Anderson. pp. 1. June 12, 1926.
Design and Construction of the Midvale Mill. Geary. pp. 7. June 5, 1926.
Selective Flotation. Parsons. pp. 2. March 27, 1926.
Selective Flotation at Bauer, Utah. Robie. pp. 3. March 6, 1926.
Selective Lead-Zinc Flotation at Sunnyside. Robie. pp. 6. May 8, 1926.
Flotation of Rand Pyritic Gold Ores. Smith. pp. 11. July 31-Aug. 7, 1926.
Grinding Efficiency and Its Relation to Flotation Practice. Roser. pp. 8. Aug. 28, 1926.

Miscellaneous Articles on Flotation

Flotation Reagents and the Behavior of Minerals in the Flotation Process. B. M. Snyder and R. Lord. Southwestern Bulletins Nos. 1-5. Southwestern Engineering Corp., Los Angeles, Calif.
Flotation of Pyrite. W. S. Morley. pp. 17. A. I. M. E. paper, 1921.

Surface Energy and Adsorption in Flotation. A. W. Fahrenwald. pp. 8. Mining & Scientific Press, Aug. 13, 1921.
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Concentration by Flotation. pp. 692. T. A. Rickard. John Wiley & Sons, New York. 1921. $7.
Manual of Flotation Processes. pp. 181. A. F. Taggart. John Wiley & Sons, New York. 1921. $3.
A Textbook of Ore Dressing. pp. 125 on flotation. S. J. Truscott. Macmillan Co., New York. 1923. $11.
Ore Dressing Principles and Practice. pp. 18 on flotation. Theodore Simons. McGraw-Hill Book Co., New York. 1924. $3.50.
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Flotation Tests of Idaho Ores. pp. 70. U. S. Bureau of Mines Bulletin No. 205. 1921.
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Differential Flotation. pp. 23. Pamphlet No. 4, Bureau of Mines and Geology, Moscow, Idaho. 1921.
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Status of Research in Ore Dressing. E. A. Hersam. U. S. Bureau of Mines, Reports of Investigations, No. 2,669.
Beneficiation of Complex Zinc-Lead Ores. A. J. Thompson and Thomas Varley, Bulletin No. 15, Engineering Experiment Station, Salt Lake City, Utah.

U. S. Flotation Patents Since Jan. 1, 1921

R indicates a flotation reagent.
A indicates a flotation apparatus.
P indicates a flotation process.
MM indicates a mechanically agitated flotation machine.
PM indicates a pneumatic flotation machine.

1921 and 1922

No.	Name of Inventor	Class
1,361,342	Margetts and Fagergren	MM
1,364,304-8	Perkins	R
1,364,858-9	Perkins	R
1,367,332	Towne and Flinn	PM
1,370,843	Sayre	R
1,374,447	Greenawalt	A
1,374,499	Greenawalt	A
1,375,087	Faul and Lavers	R
1,375,211	Cole	A
1,375,233	Scott	P
1,378,562	Sayre	R
1,378,920	Towne and Flinn	PM
1,380,650	Hebbard	PM
1,380,665	Lyster	A
1,383,321	Marcy	A
1,383,881	Thomas	A
1,389,674	Lyons and Hoff	A
1,390,080	Boggs	A
1,393,821	Otsuka	MM
1,394,306	Hynes	A
1,394,639-40	Perkins	R
1,394,958	Schwartz	P
1,397,703	Robbins	R
1,397,815	Luckenbach	PM
1,398,394	Robbins	A
1,398,989-90	Wilkinson	R
1,399,539	Bonnell	PM
1,400,308	Moffat	P
1,402,099	Shimmin and Bushnell	MM
1,407,258	Connors	PM
1,412,215	Patterson and Woolfenden	
1,413,723-4	Groch	MM
1,415,105	Moffat	PM
1,415,314	Colburn	MM
1,415,899	Sayre	R
1,417,261-2-3	Luckenbach	R
1,417,895	Fahrenwald	MM
1,418,514	Bailey	P
1,420,138-9	Peck	MM
1,427,232	Schwarz	R
1,438,435-6	Fredrick	R
1,438,590	Forrest	R
1,439,061	Broadbridge, Edser and Sellers	P
1,439,107	James	R
1,440,129	Borcherdt	PM

1923

No.	Name of Inventor	Class
1,441,560	Connors	PM
1,442,306	Stonebraker	PM
1,444,552	Nokes	MM
1,445,042	Ruth	P
1,445,989	Borcherdt	P
1,446,314	Myers	P
1,446,375-6	Borcherdt	P
1,447,006	Barker	P
1,448,929	Luckenbach	R
1,449,797	Vivian	P
1,452,662	Smith	P
1,454,656	Rork and Sandberg	MM
1,454,838	Borcherdt	P
1,457,077	Janney	MM
1,457,680	Whitaker	P
1,458,016	Wigton and Seddon	P
1,458,467	Dolbear	P
1,459,167	Smith	P
1,463,405	Ruth	MM
1,469,042	Hellstrand	P
1,470,350	Court	MM
1,473,160	Robbins	MM
1,473,192	Luckenbach	R
1,476,530	McCullough and Wilson	R
1,478,697	Bragg	P
1,478,703	Dolbear	PM

1924

No.	Name of Inventor	Class
1,480,884	Dolbear	P
1,483,115	Rork and Sandberg	MM
1,483,270	Barrows	P
1,486,297	Pallanch	P
R-15,802	Scott	P
1,488,745	Ellis	P
1,490,736	Frederick	R
1,491,863	Janney	R
1,492,904	Sulman and Edser	R
1,492,933	Parker	MM
1,497,310	Tucker and Edser	R
1,497,696	Sayre	R
1,505,323-4	Eberenz	P
1,505,944	Broadbridge and Edser	P
1,506,385	Rhodes	R
1,507,089	Rosenstein	R
1,508,478	Scott	P
1,512,139	Sayre	R
1,513,812	Henderson	P
1,518,010	Simpson	PM
1,521,277	Christensen	PM

1925

No.	Name of Inventor	Class
1,526,997	Malmros	PM
1,537,265	Ruth	PM
1,547,548	Allen and Reid	PM
1,549,316	James	R
1,549,492	Kraut	MM
1,550,512	Cremer	P
1,552,936-7	McArthur	P
1,554,216	Keller	R
1,554,220	Lewis	R
1,559,504	Crowell and Breckenridge	R
1,567,501	Herman	PM

1926

No.	Name of Inventor	Class
1,573,226	Croasdale	P
1,574,403	Meyer	PM
R-16,279	Ellis	P
1,579,722	McAtee	PM
1,587,789	Morse	R
1,588,077	Wilkinson and Littleford	MM
1,590,196	Clees	R
1,593,232	Whitworth	R
1,594,858	Stevens	R
1,595,795	Littleford	R
1,595,796	Littleford	P
1,597,368	Meyer	PM

What Is Whiting

"What is 'whiting'? Where is it mostly produced and its price per ton? What is the simple analysis of it? What is there in its kindred line that is more or less substituted for whiting? What is the difference between whiting and fuller's earth?"

Whiting is pulverized chalk or pure calcium carbonate. In the commercial product, however, there is often contaminating material. Also a number of substitutes often sold as whiting are made from a variety of calcareous material. Pulverized marble or limestone made from scraps that accumulate around quarries makes whiting. The current price is from $1 to $1.50 per hundred pounds, depending upon the quality and fineness. True chalk suitable for the manufacture of whiting is not produced to any extent in the United States, but is imported from European countries.

Fuller's earth is an entirely distinct product, though it is also a clay-like material. It is a hydrous aluminum silicate essentially, although the composition may vary widely. Its characteristic quality is its ability to absorb basic colors from oils of various kinds. To the extent that both of these materials may be used as "fillers" in the manufacture of various products, they are alike; but in composition they are entirely different.

Useful Operating Ideas

Specific Gravity Determination for Solids

By W. H. Seamon

Professor of Mining and Geology, College of Mines, University of Texas, El Paso, Tex.

The specific gravity of any solid is found by dividing a given weight of the solid by the weight of an equal volume of water, under standard conditions. The usual method employed requires a balance and a specially designed apparatus. The equipment is relatively expensive and considerable time is required. For some time I have employed a 10 c.c. graduated glass cylinder and a cheap balance, all of which could be carried safely in the pocket. It has proved satisfactory for quick field tests. The method of use is as follows: Break the solid to fragments, none larger than one-fourth of an inch; weigh quickly from 4 to 5 grams. Fill the cylinder up to the 5 c.c. mark with any liquid that will not act on the solid; introduce the weighed solid into the liquid quickly, tapping to release gas bubbles and read the increase of volume of the liquid as accurately as the graduations and the eye permit. The increase in volume, expressed in cubic centimeters, divided into the weight in grams is the specific gravity.

The following table gives the results I have obtained by the old and the method just described:

Mineral	Old Method	New Method
Graphite	2.15	2.06
Iron	7.3	7.17
Realgar	3.5	3.54
Molybdenite	4.7	4.64
Sphalerite	4.11	4.17
Pyrite	4.96	4.76
Anorthite	2.75	2.64

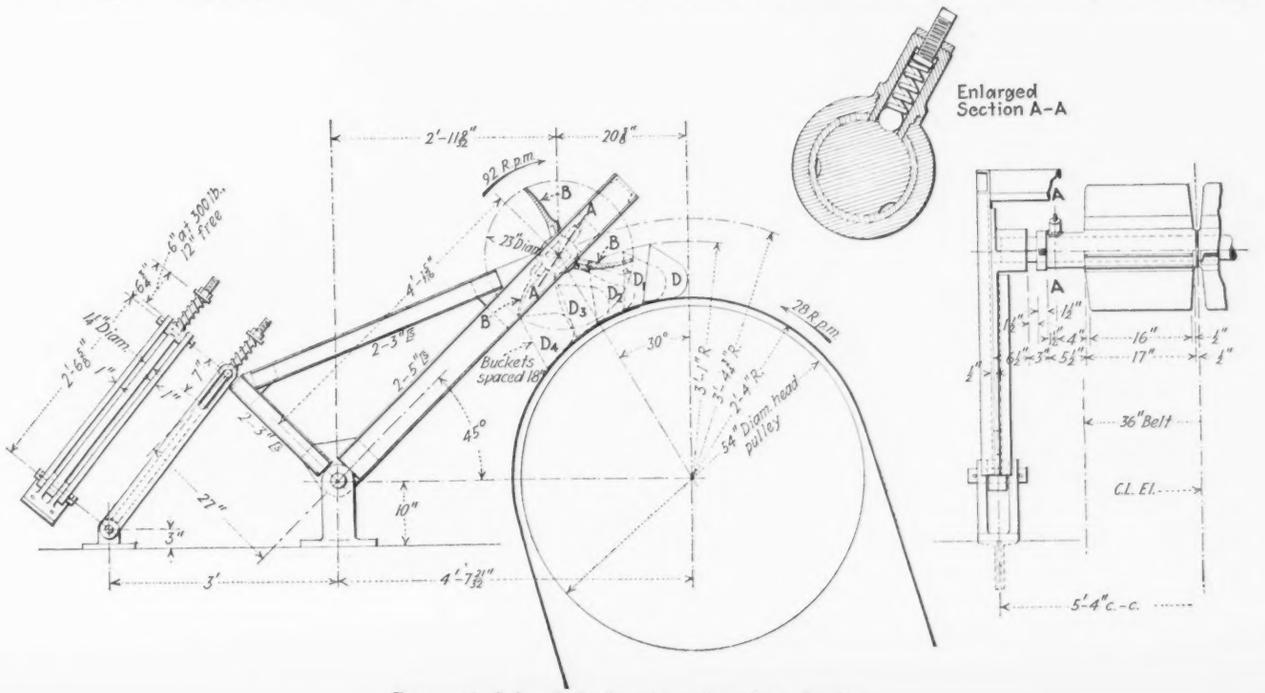
The method can be, and has been, employed in mills and other places where 50 to 100 grams of solid is conveniently available by pouring 100 c.c. of fluid into a graduated cylinder that will measure up to 150 c.c., adding the solids, shaking to displace air, and noting the increase in volume.

Cleaning Device for Elevator Bucket

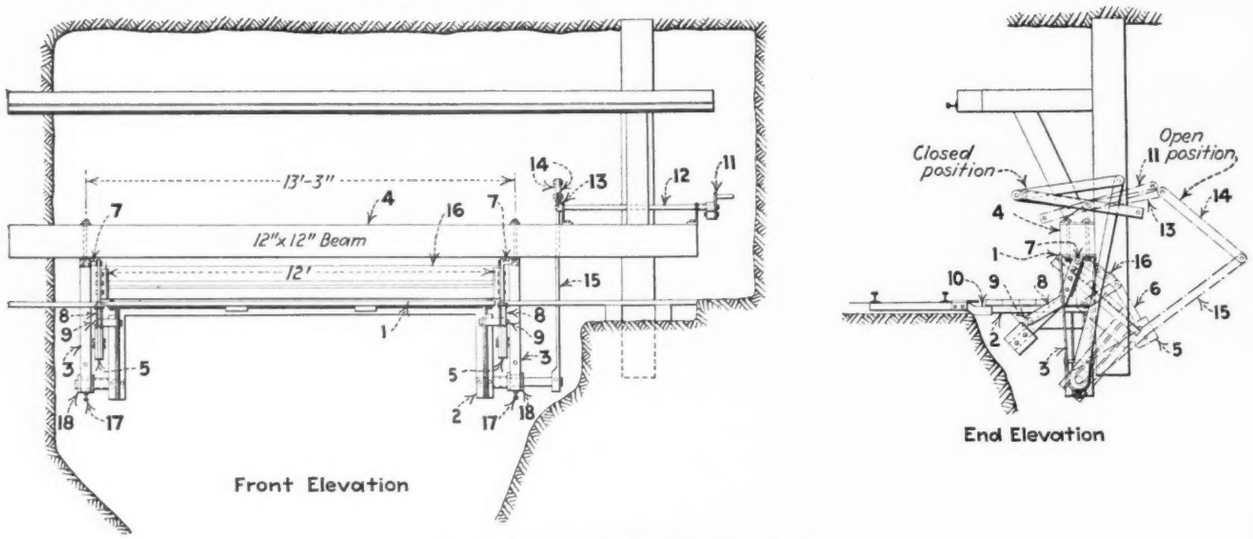
An ingenious device was recently designed by the engineering staff of the Utah Copper Co. for cleaning elevator buckets when charged with wet and sticky ore. Under such conditions the buckets do not completely discharge and the accretion tends to build up, interfering with the proper operation of the bucket elevator. The device consists of a revolving scraper wheel mounted upon a triangular-shaped frame, shown in the accompanying illustration. A certain amount of play about a fixed radius is allowed, but the scraper wheel frame cannot interfere with the elevator-bucket clearance. To prevent spinning of the scraper wheel, a spring-actuated brake, shown in the enlarged section *A-A*, is attached to the hub of the scraper wheel.

The scrapers *B* revolve and are so timed that they engage the elevator bucket *D* at D_1. As the bucket travels forward, scraper *B* moves along the upper side of the bucket to the bottom, as in D_2, and by the time the bucket occupies the position of D_4, the scraper leaves the bucket. Traveling at different speeds, as they do, will necessitate exact construction and accurate timing.

A model of the device was constructed and the idea proved out on a small scale, but it was never installed in the milling plants at Garfield. The probability of its satisfactory operation is open to question, but it is presented here as an illustration of ingenious design.



Suggested bucket-elevator cleaning device



Ore transfer gate at Dome mines

Waste and Ore Transfer Gate

By C. S. Watt
Assistant Mechanical Engineer, Dome Mines, Ltd., South Porcupine, Ontario

Receiving openings of waste and ore transfers, or bins, require protection, and this is afforded best by platform doors, grizzlies, or other devices. At the Dome mines, at South Porcupine, Ontario, a platform door was designed and installed for this purpose. It has been in use for about a year and has proved safe and easily operated. The illustration shows the front and side elevations with the platform door closed and also in the open position.

The door platform is 12 ft. long, 30 in. wide, and 3 in. thick, and is constructed of fir. It is secured with bolts to an angle-iron frame, 2, the frame being pivoted on two hangers, 3, which are fastened to a 12 by 12-in. beam, 4. The door is balanced by two weights, 5, one at either end attached to the bent bars, 6. The bent bar is pivoted on a pin, 7, which is fastened by the same bolts that support the hanger. Between the balance-weight bar and the door frame, 2, are two links, 8. In the closed position the weights assist in opening the door, and as they swing past the center line they also assist in closing the door.

In the closed position the balance-weight bar bears against the pin, 9, to which the connecting links are attached to the door frame, thus acting as an additional stop for the door besides the two stops, 10, that are fastened under the track rails.

The door is operated by a counterbalanced lever, 11, fastened to the operating shaft, 12. Another lever, 13, is fastened to this shaft, two connecting links, 14, being attached to the long door frame lever, 15. To open the door the counterbalanced hand lever is turned 180 deg. to the right, when the door stops against the 12 by 12-in. beam.

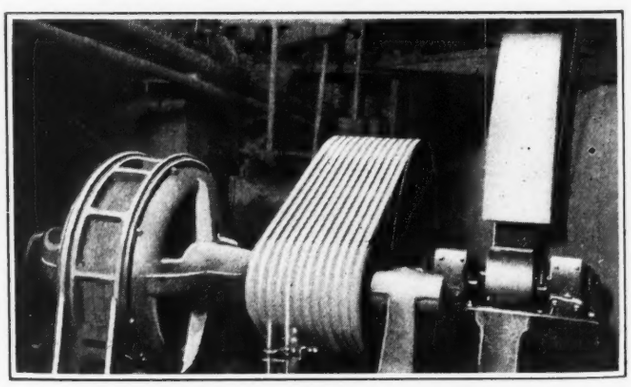
A curtain plate, 16, is fastened with bolts to the two balance-weight bars so as to close the space between the 12 by 12-in. beam and the platform door. This is necessary where the transfer or chute is near a crusher station. By this arrangement the chute is closed in and the station kept free from dust. To level the door, jack screws, 17, are tapped into the hangers, 3, and the bearings, 18, are adjusted to suit the conditions.

Doors are made in 12 and 14-ft. lengths and are so balanced that very little effort is required to close and open them, either operation taking about two seconds. The hand-operating lever can be replaced by a chain wheel and operated by an endless chain, supported on idler wheels, above the track where it is necessary for the motorman to open the door as he approaches the transfer.

Rope Drive vs. Belt Drive

By Gail Martin
Salt Lake City, Utah

The Combined Metals Reduction Co., Bauer, Utah, is the first metallurgical company in the intermountain section to make use of the Allis Tex rope drive of a type similar to the drive used on automobile fans. All of the drives on the Fagergren flotation machines and the Hardinge ball mills have been changed to the rope type, which combines the advantages of silence, flexibility, lack of vibration and slipping, short belt drive, and large reduction. On the 25-hp. drive Fagergren flotation machines, a drive costing $140, consisting of eight-strand rope has replaced four pulleys, a jack shaft, two bearings and belts worth $96. Experience of the Combined Metals staff indicates that rope drives will last twelve months as compared to three or four months for the belt drive. Replacement cost of rope drives should not exceed $16 a year as compared with a replacement cost of at least $274 annually for the old type of belt drive.



Tex rope drive on Hardinge ball mill a new adaptation at the Combined Metals flotation plant

News of the Week

The Mining News given in ENGINEERING AND MINING JOURNAL is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary

BUREAU OF MINES is considering joint research work with Bolivia on low-grade Bolivian tin ore; lack of tin deposits in the United States may result in Congressional sanction.

France developing fluorspar deposits—Antwerp diamond market improves—Howey Gold Mines ready to develop Red Lake property.

Ford names new Michigan iron mine "Blueberry"—Oliver installs compressor at Section 16 mine—Witherbee, Sherman & Co. at full capacity.

Trimountain production 200,000 lb. of copper per month—Mayflower-Old Colony crosscut 2,300 ft. from shaft.

West End Consolidated makes regular shipments from Mabel mine.

Combined Metals producing $125,000 per month—Utah Copper builds new camp at Bingham—Midvale flotation plant increases capacity to 800 tons daily—Texas potash deposits to be investigated by State Bureau of Economic Geology.

Kootenays chief center of British Columbia mining—Premier pays 8 per cent dividend—Paradise mine bonded.

Italy to conserve lead and zinc ores for domestic uses—Exports from Belgian Congo to United States increase.

White Caps encounters ore on lower level—New Southern Pacific line from Phoenix to Yuma, Ariz.

Tanganyika Goldfields may become important tin producer.

Tonopah Extension Loses in Bullion Tax Appeal in Nevada

The Nevada State Supreme Court has handed down a decision in favor of the state in the appealed bullion tax case of the State vs. the Tonopah Extension Mining Co., Tonopah, Nev. This decision nullifies certain deductions which the mining companies have used in calculating their bullion tax due the county and state and is of importance to the entire mining industry of Nevada.

The Nevada State Constitution provides for a taxation of the net proceeds of the mines, but the act failed of sufficient detail to make clear just what deductions would be allowed in determining the "net proceeds." The State Tax Commission refused to allow depreciation, insurance, taxes, or cost of office maintenance outside the state. Different companies, in the absence of official information on the subject, used different methods of calculating bullion tax. Many companies made payment on certain of these items under protest, thus protecting themselves against tax penalties.

In 1919 a test suit was brought against the Tonopah Extension Mining Co., but no real action was taken and no decision rendered until 1925, when Judge Frank T. Dunn, in the Fifth Judicial Court, in Tonopah, rendered a decision in favor of the state. An appeal was made and the case tried in the Nevada State Supreme Court, and decision of the lower court was upheld.

It is estimated that $180,000 is due as additional bullion tax under the decision, the Nevada Consolidated Copper Co. being the largest individual delinquent. At the next meeting of the Nevada Tax Commission definite plans for settlement and collection probably will be determined upon.

Heroism Rewarded

Chauncey L. Berrien, superintendent of mines of the Anaconda Copper Mining Co., in behalf of the company presented six of the employees with a check of $200 each for heroism displayed in removing powder from a flaming magazine on the 2,800-ft. level of the Mountain Consolidated mine Aug. 18. Accompanying the check was a letter which stated in part:

"By your quick action and bravery in this emergency you not only prevented the possible loss of life to your fellow miners, but also great loss to the mine. We commend you most highly for your actions." Recipients of the gift and letters were: Mike Gavigan, assistant foreman; James H. Murphy, shiftboss; John W. Rodecheck, Thomas D. Kilgallon, James Preston and Jerry D. Murphy, miners.

Callahan Mill Ready Oct. 15

The new mill of the Callahan Zinc-Lead Co., Interstate, Idaho, at the Galena mine will be ready for operation Oct. 15, after which the company will begin the remodeling of the mill at the Callahan mine on Nine Mile, it is announced at Spokane, Wash.

Most of the equipment for the Galena mill has already arrived and much of it is in place.

Forty-three Miners Caught by Cave-in at Ironwood

Cut off by many tons of boulders which gave way in the G. Pabst iron mine at Ironwood, Mich., Sept. 24, forty-three men were trapped hundreds of feet below the streets of that city. At least three men are dead. Boulders loosened by vibration a short distance from the surface fell down the 2,600-ft. shaft. As one plunged down others were loosened, to fall in a pile of débris at the bottom of the shaft.

The steel cage of the shaft was below the break in the shaft wall. The cage, caught by the first rush of boulders, was torn from the cable and it shot down the 45-degree incline with terrific speed. It crashed against the bottom, and a moment later the many tons of rock fell upon it. In the cage were Thomas Rowell, underground electrician, and two of his assistants, Ever Gustafson and Gust Sell, all of whom were killed.

On the eighth level of the mine was a crew of at least thirty-two men. A check disclosed that six others also were missing. There is no danger from water or gas, and the possibility of death by suffocation is remote.

One rescue crew set to work drilling a hole through 400 ft. of débris which blocks the shaft. At the same time another crew, which had entered an adjacent mine a half mile from the wrecked shaft, had started digging from a lower level hoping to connect with the mine level on which the men are trapped. More than 400 men are engaged in the rescue work. On Sept. 28, the miners were still entombed.

Trimountain Mine on Profitable Production Basis

Trimountain mine of the Copper Range company, Trimountain, Mich., is now producing sufficient copper to return a profit. For the last six years Trimountain has shown a deficit. In August Trimountain production was brought up to 200,000 lb., the increase making for lower costs. Yield is around 30 lb. of refined copper per ton. New ground is opening well in copper content. For the last three years Trimountain has been on a development basis, and good stoping areas now are available. The mine has two working shafts, Nos. 2 and 4, but only No. 2 is in commission. Nos. 1 and 3 have been abandoned, but ground contiguous to them and also No. 4 is being reached through No. 2. Electric haulage makes this possible.

The Champion mine of Copper Range is showing a larger percentage of copper ground at depth in No. 4 shaft than in levels immediately above. In Baltic, a large area of stoping ground has been opened by a raise from the 40th level of No. 3 shaft to the 31st, at the south end of the mine. Stopes in working levels in this stretch of 1,000 ft. are yielding high-grade rock.

Rock bins at both the Champion and Baltic stamp mills are being reinforced with concrete. Only the Champion mill is in operation, but the Baltic plant is being kept in repair for the time when it will be needed.

Sidney Tram Nears Completion

The tram of the Sidney Mining Co., Kellogg, Idaho, will be completed from the mine on Pine Creek to the smelter at Kellogg in a few days, and will go immediately into operation, according to reports received at Spokane, Wash. The company is now shipping 50 tons of ore daily by truck, and as soon as the three and a half mile tram is finished the shipments will be doubled and made over the tram.

Montana Mining Notes

The flotation plant of the Maxville Gold, Silver, Mining & Development Co., Maxville, Mont., has made a trial run. Commercial milling operations will start shortly under supervision of George W. Quigley.

W. F. Newton and associates, Trout Creek, Mont., who have been working the old Vermillion mine near Anaconda, penetrated a fault on the old No. 3 level and opened six feet of high grade lead-silver-zinc ore at a depth of 500 ft. below the surface.

The management of North Butte Mining Co. reports that leasers are now working on all levels from the 500 to the 2,800 in the Granite Mountain property and in the first half of September shipped 750 tons of zinc ore and 2,250 tons of copper ore.

Dan McCoy and associates have shipped a car of high-grade copper ore from properties which they are leasing at Dillon, Mont.

Bailers have been installed to augment the "air lift" in unwatering the Belgrade shaft of the Ardsley Butte Mining Corp., Elk Park, Mont. F. T. Morris, of the engineering firm of Harper, McDonald & Co., Butte, has been appointed consulting engineer.

For the fiscal year ending June 30, 1926, net proceeds of mines tax in the Butte district amounted to $494,973.71, an increase of $283,600.23 over 1925 and $242,439.26 over 1924. Payments included in above are from Anaconda, Butte & Superior, Anselmo Mining Co., Butte Copper & Zinc Co., Lizzie Lease and North Butte Lease.

Small Mines Active in Madison County, Mont.

The Mammoth mine is now being operated by the Liberty-Montana Mining Co., Mammoth, Mont. About 60 men are employed.

Mohave Mining Co., Twin Bridges, Mont., is developing the old "B & H" property in Bear Gulch. A new mill is being built as well as new buildings for a camp, offices, and other necessary structures.

George Bosanatz is shipping regularly from the Deutchland mine, about 7 miles north of Sheridan, Mont. Only a few men are employed. High-grade lead ore is being shipped to East Helena.

Messrs. Ray Bullardick and Ed Bluhm are putting up a three-stamp mill on the Spotted Horse property, in Ramshorn Gulch, Sheridan.

The Searchlight Mining Co., Idaho Falls, Idaho, is building a concentrator at the Paymaster mine at the head of Bivin Gulch, Madison County, Mont.

Tamarack Mine, four miles east of Sheridan, is operating its mill twenty-four hours a day, on a free-milling gold ore. Twelve men are employed.

Gladstone Mines & Reduction Co., Sheridan, Mont., employs about twenty men at the Lakeshore mine, at the head of Wisconsin Creek.

The Winnetka Mine, four miles from Virginia City, Mont., has lately started its amalgamation-flotation mill.

The Barton Gulch Mining Co. of Utah, Virginia City, Mont., has a small force of men employed at the Barton Gulch property above Alder.

Abandoned Joplin Mines Drilled Deeper

Many of the old mining lands of Missouri, around Joplin, Webb City and Granby, are being leased and drilled deeper than when mining was formerly done in this field, in hopes of finding deeper runs of ore, like those found in Oklahoma. Some of these old diggings are rich in calamine and their being mined again may put considerable calamine on the ore market, as in the olden days.

Witherbee, Sherman & Co. Operating at Full Capacity

The placing of equipment in the Tunnel mine of Witherbee, Sherman & Co., Mineville, N. Y., is under way. Operations will be resumed soon. The reopening of this mine will provide employment for a large number. This is the last of the company's three mines to resume, effecting full blast operations the first time in several years.

Ford's New Iron Mine Named Blueberry

The new iron ore mine which is being opened by Henry Ford on the Marquette range, near Ishpeming, has been named the Blueberry. Mr. Ford and his son, Edsel, recently paid a visit to the property and busied themselves for quite a while picking blueberries, which are very abundant on the lands taken under lease from the Barnes Land Co. When asked what name should be given to the new mine, Mr. Ford suggested Blueberry, and this was agreed to.

The shaft is now going down, with the 1,000 ft. point as the first objective. Equipment is being received, and some of the materials for the mine buildings are on the ground. The shaft will be concreted to the ledge. It will be at least a year before mining operations are under way.

Oliver Installs New Compressor at Section 16 Mine

A new compressor has been received at the Section 16 mine of the Oliver Iron Mining Co., on the Marquette range, Michigan, and the mine will be closed for about three weeks while this is being installed and a new 8-in. air column placed in the shaft to a depth of 1,200 ft. The new compressor was manufactured by the Ingersoll-Rand Co. and has a capacity of 3,000 cu.ft. of air per minute. It will be the largest on the Michigan iron ranges, the largest now in operation being of 2,500 cu.ft. capacity.

Mayflower Crosscut Now 2,300 Ft. From Shaft

The Mayflower-Old Colony exploration in the Michigan copper district, in territory not heretofore investigated, is important not alone to Mayflower but to neighboring properties. The exploratory crosscut now is 2,300 ft. from the shaft or about half way across the property. It will be continued for the full width to obtain a complete cross section. This is the first extensive opening in Mayflower and is being driven at a depth of 1,700 ft. Only the St. Louis amygdaloid and a vein of the Arcadian series have been cut, without disclosing commercial rock. It is expected that lodes will be cut in the remaining stretch and there is speculation as to what they will reveal.

Monarch and Boise Rochester Mines Consolidated

The St. Joseph Lead Co. and the Barnsdall estate have announced that the Monarch and Boise Rochester mines, Atlanta, Idaho, will be consolidated and reopened. The Monarch mine, owned by the Atlanta (Idaho) Mines Co. and controlled by the heirs of the late Captain Barnsdall, has not operated for many years. During the war it was opened for a period of sixty days, and $60,000 was produced, which amount was not considered sufficient to continue operation. The Boise Rochester mine, owned by the St. Joseph Lead Co., has been closed several years. This company has been unwilling to resume operations until it gained control of the Monarch, which is an adjacent property.

Fluorspar Deposits in France Under Exploitation

The exploitation of fluorspar deposits in the Department of the Var, France, is being carried on steadily, according to the U. S. Department of Commerce. The construction of the railway from the two mines to the seacoast, a distance of 10 to 15 miles, is being pushed forward and its completion is looked for in the course of a few months. In the meantime production continues at the rate of about 1,000 metric tons per month and stocks are accumulating. The output is expected to double in the near future. Exports to the United States during the first half of 1926 consisted of shipments of a total weight of 970 tons, valued at $8,368.

C. C. Julian Buys Control of Monte Cristo

Control of the Monte Cristo Mining and Milling Co., Constellation, Ariz., has been purchased by C. C. Julian of Los Angeles, Calif., from Ezra Thayer of Phoenix. The mine is in the Black Rock Mining District, about ten miles east of the town of Wickenburg, on the Santa Fe, Prescott and Phoenix Railroad.

The property has been developing ever since incorporation of the company fifteen years ago, but no ore has ever been shipped. The shaft is down to the 1,100-ft. level and several thousand feet of crosscutting have been driven.

West End Consolidated Ships from Mabel Mine

The West End Consolidated Mining Co., Tonopah, Nev., reports that Lot No. 63 from its Mabel mine, near Mina, Nev., was settled for on the following basis: gold, 1.03 oz; silver, 181.2 oz; lead, 6.45 per cent. Total value per ton of $146.00. This represents the regular monthly car from the property, and is slightly above the average of $120 per ton for all ore shipped.

Work in the Mabel mine is being conducted on the 300 and 500 levels from the vertical shaft. The veins are narnow, rarely exceeding eighteen inches of ore, and are usually smaller, but with the grade of ore uniformly high.

Howey Gold Mines to Develop Red Lake Property

The Howey Gold Mines, Ltd., is now in a position to go ahead with developments of its property at Red Lake, Ontario. Holdings of the Dome Mines, Ltd., of shares in the Howey company have been acquired by John E. Hammell on behalf of the Howey, on terms satisfactory to the latter. The Dome held 671,496 shares under the terms of the option, which stock was secured in consideration of development expenditures at the Howey property. This entire block of shares now reverts to Mr. Hammell, who will turn it over to the Howey Gold Mines. The transaction comes as a culmination of several months' effort on the part of Mr. Hammell to secure control of the Howey situation so that an energetic campaign for development could be conducted. The directors will now be able to consider financing the operations.

Washington News

By PAUL WOOTON

Proposed Joint Research Work on Bolivan Tin Ores

Something is going to be heard on the subject of tin at the forthcoming session of Congress. The prospect that world production will decrease in the face of the rapidly increasing consumption of this metal has been brought forcefully to the attention of members of Congress in the areas where tin consumption is large.

As a result of the raw material monopoly survey made by the Department of Commerce and of the regular work of the Bureau of Mines, the executive branch of the government is fully aware of the serious situation which faces a nation using more than half of the tin produced in the world, although its domestic output is but a fraction of 1 per cent of its consumption.

It is recognized that the most promising step that can be taken to protect American consumers is to undertake research work on the beneficiation of the low-grade, complex Bolivian ores and on the reduction of barilla by some hydrometallurgical process.

All indications are that the mining of tin will contine in Bolivia long after the other fields are exhausted. Comparatively speaking the resources of that country hardly have been scratched. Tin occurs on both sides of the Andes in Bolivia. The field probably extends into Argentina.

Tin mining in Bolivia has been slow to develope, largely because of the many problems offered by the complex ores. If these problems can be worked out under American auspices there would become available to the United States the most important source of tin in the world. Potosi Hill, it is estimated, has nearly 2,000,000 tons of positive and probable ore running more than 1 per cent tin and 10 ounces of silver. The Salvador mine, another great property, with positive and probable ore estimated to contain some $50,000,000 in tin, silver, and zinc values, is unable to operate because of metallurgical difficulties. In addition there are the Cantumarca and Arafilia alluvial deposits. The Guggenheim interests are about to begin dredging in the latter region. Carolina de Caracoles is trying to operate with an absurdly inadequate mill, but has a wide lode of low grade ore. The Calquiri property, near Oruro, has a lode 100 ft. wide, but it hardly has been prospected. This list could be extended indefinitely and is referred to so as to give an indication of the great possibilities of the only remaining uncontrolled tin-producing area. If the United States assists in its development and helps on the research work it is believed Bolivia would be willing to subscribe to a plan that would insure consumers against manipulation.

It is expected that proposals will be brought forward at the next session of Congress looking to the undertaking of research work on some of the metallurgical problems which are encountered in Bolivia.

Sellards Investigates Potash Supplies

In a report which he has just made to the Board of Regents of the University of Texas of his recent investigations of the potash mines of Germany, France and Spain, Dr. E. H. Sellards, associate director of the Bureau of Economic Geology of the University, calls attention to the fact that more than two-thirds of these mining plants in Germany have suspended operations. Of the more than two hundred plants, only between sixty and seventy are now running, and these are under government control, each with a given quota of potash production. Dr. Sellards says: "Extensive mining of potash minerals is carried on at present only in Germany and France, although one mine is operating in Poland and in Spain production on a commercial basis has been initiated during the past year. These four countries supply about 97 per cent of the world's production of potash. The purpose of my observations in Europe was to compare conditions of occurrence of production in these countries with the known occurrences in Texas to serve as a basis for subsequent further study of the Texas deposits."

Red Top Makes Initial Shipment

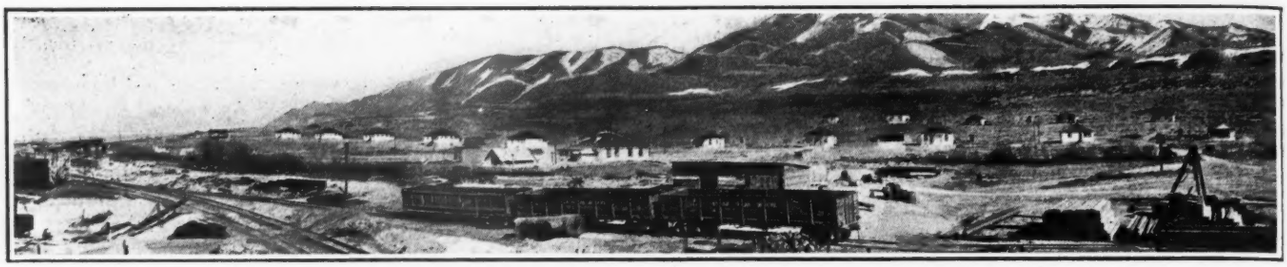
The Red Top Mining Co., Spokane, Wash., has received returns from the Bunker Hill smelter for a 20-ton car of ore taken from its tunnel in northern Stevens County, Washington. The net return was $842. The ore carried 16.3 oz. in silver and 33.25 per cent lead. It was penalized for zinc, $1.17 a ton, and for antimony, 20c. a ton. Treatment charges on the shipment were $11.50. J. Richard Brown, mining engineer in charge, says no more shipments will be made until the tunnel, now in 600 ft., reaches the main oreshoot, which is about 200 ft. further in.

Idaho Hewer Resumes

D. M. Drumheller, Spokane, Wash., manager of the Idaho Hewer mines on Pend Oreille Lake, Idaho, reports that sinking has been resumed from the 200 level in the shaft and 400 ft. from the surface. The shaft was sunk from the tunnel level last fall and the vein has been explored by drifts and crosscuts on the 200 level for nearly 1,000 ft. Mr. Drumheller reports that this work revealed high-grade silver-lead ore and a general improvement over conditions on the tunnel level 200 ft. above.

Diamond Market Improves

The improvement in the diamond market of Antwerp, Belgium, became more marked during July, and according to the U. S. Department of Commerce there was a steady increase in the demand for polished stones in spite of the fact that some of the transactions have been slow. Prices on this class of goods have been increasing gradually. Fine white stones of good quality have sold well and there has been a brisk demand for big stones. The improved market for polished stones naturally had a favorable influence on that for rough stones.



Bauer, Utah, where the Combined Metals Reduction Co. is operating a flotation plant and perfecting a leaching process

Flotation and Leaching Plant of Combined Metals Producing $125,000 per Month

By Gail Martin
Salt Lake City, Utah.

The Combined Metals Reduction Co., Bauer, Utah, is operating the Honerine property, the oldest mine (discovered in 1865 by Gen. Conners) in Utah, by modern mining methods and equipment and a system of ore treatment that perhaps stands as one of the most recent developments in metallurgy. Aside from its interest to the mining engineer as a demonstration of what modern methods will do to revive old mines, the ore treatment will command the attention of the metallurgist and mechanical engineer as well. For at Bauer—but a few miles from Stockton and Tooele, where is situated the International Smelting Company's plant—a process is being pioneered that will permit the production of metallic lead direct from crude ore without any roasting or smelting. The flow sheet of the flotation plant, now treating from 180 to 200 tons daily, varies but little from that of any selective flotation plant. Information concerning the reagents used is withheld by the company until patents are secured. However, that the Combined Metals method is successful is indicated by the company's ability to treat zinc-lead ores carrying a 64 per cent pyrite gangue and make a 51.5 per cent zinc concentrate with but 2 per cent lead and a lead concentrate assaying 40 per cent lead with but 4 per cent zinc, and that during 1925, the company produced from its flotation unit alone 1686 oz. of gold, 373,025 oz. of silver, 8,666,000 lbs. of lead, and 10,512,000 lbs. of zinc. In its present embryonic state, without operating its leaching plant which company officials plan to start up within a year, the company is producing $125,000 a month in metal and employing 200 men.

It is in the field of solving mechanical difficulties by designing new equipment that the Bauer project possesses the most interest for the metallurgist. An illuminating example of the troubles experienced in evolving the process from the pilot plant to the commercial stage is the company's difficulty in securing a suitable filter cloth. At this point, it should be said that the metallurgy as worked out by N. C. Christensen, Salt Lake metallurgical engineer, checked perfectly. Delays have been due to mechanical difficulties. In the pilot plant erected at Florence, Colo., a standard wool filter cloth gave excellent service over a period of three months. When tried out at Bauer on a commercial scale, this same cloth deteriorated in periods ranging from five to ten hours. Finally, a filter cloth made out of 100 per cent South African blue asbestos was secured. This withstands the corrosive action of the hot acid for a period ranging from 90 to 120 days.

One of the developments growing out of the Combined Metals enterprise is the Christensen spray, which can be used efficiently wherever it is desired to heat, cool, cleanse or humidify fluids on a large scale. The Christensen spray is already finding application in the baking industry and in ventilation of theaters and public buildings where it is desirable to maintain a uniform degree of humidity and a uniform temperature. To leach the metal out of the ore by the Combined Metals process, large volumes of acid must be heated to the boiling point, which could not be done by any existing method. As a result the Christensen spray heater was evolved by N. C. Christensen and W. H. Kelsey and this device has made the heating of hot acid solutions inexpensive and simple of operation. The Christensen spray heater consists of a brick structure providing a chamber having an inside length of 100 ft., a width of 4 ft. and a height of 7 ft. Gases from a furnace 20 ft. long, fired by an automatic American stoker, are drawn over a bridge wall and through a combustion chamber by a multivane fan revolving 1,000 r.p.m. placed at the rear of the heater. The spray compartment, 80 feet long, is lined with acid proof brick and set in acid proof cement.

The acid solution is introduced from storage tanks by a four-inch wood-stave pipe into the rear end counter current to the combustion gases. Proper depth of solution is maintained in the bottom of the chamber by a weir at the discharge or furnace end. Six 18 x 48 in. drums set 10 ft. apart revolving 500 r.p.m. dip into the solution at a depth varying from $\frac{1}{16}$ to $\frac{3}{16}$ in. and discharge the solution in the upper part of the chamber in a form varying from a mist to a heavy spray, depending upon the depth of submergence. The hot gases circulating through the chamber heat the spray solution before it flows over the weir to 98 deg. C. The revolving drums are made of cast iron and coated with acid proof cement.

The Combined Metals staff claims that the extreme simplicity and flexibility of this type of heater make it unrivalled in the field of heating, cooling or humidifying. It has 1200 times the absorbing area of an acid tower of the same dimensions. Fuel efficiency is exceptionally high. For a small cost, 1200 tons of solution daily can be raised from a temperature of 20 deg. C. to 98 deg. C., so thoroughly is all the heat absorbed. The cooled furnace gases are discharged through a wooden stack by a multivane fan.

The hot acid is pumped from the heater to the pug mill where it is mixed with ore crushed to minus 200 mesh. The pulp is then conveyed to agitators where the acid is added. Rapid formation of hydrogen sulphide at this stage caused frothing which promised to reduce the capacity of agitators to a minimum. The invention of paddles set on a wooden cross arm solved this problem by stirring the solution, thus allowing the gas to escape. Study of this department of the leaching plant gives some interesting comparisons. Flow in the Combined Metals leaching process is continuous as in a flotation mill. Leaching is completed in twenty minutes as compared to hours required by other processes.

Combined Metals metallurgical plant showing flotation and leaching units, at Bauer, Utah

To cool the solution and precipitate the lead without roasting, chemical or electrical precipitation, the Christensen spray again comes into use. The cooler is constructed the same as the heater, save that there is no furnace. Air instead of hot gases is drawn through the cooling chamber at the rate of 40,000 cu.ft. a minute, the solution sprayed into the circulating current and cooled and the lead dropped in the form of a

lead chloride, from which the chlorine is volatilized.

The last mechanical difficulty presenting itself was the construction of a special filter since standard makes proved impractical. Distribution of the cake in the filter leaves was uneven, and the solution not clear. To overcome these difficulties, a new filter was designed which makes a crystal clear solution, takes advantage of the rapidly settling character of the precipitate, and makes a uniform cake. Thus the last mechanical difficulty has been overcome, insuring operation of the leaching plant within a year.

Utah Copper Builds New Camp

Copperton, Bingham's new residential district, consisting of eighteen bungalows being constructed by the Utah Copper at the mouth of Bingham canyon, will be completed about Dec. 1. The new community was necessitated by crowded living conditions in the old camp and the need for new dumping space. The cottages are of hollow tile and range in size from four to nine rooms. The expenditure for the houses will total about $110,000. Copper will be used in the construction of the houses wherever possible, including copper-plated shingles, copper gutters, copper downspouts, and copper smokestacks. All plumbing will be of brass.

More men are employed in and around Bingham than at any time in the history of the camp.

Otisco Mine Has Four-Foot Orebody

Lewisohn interests, operating the Otisco property, in the south central portion of Butte, Mont., have cleaned out the west 200 level and opened a body of lead-zinc-silver ore more than four feet wide. Work is being done under the supervision of Glenn Anderson, Butte mining engineer.

Canada del Oro Being Prospected for Placer Gold

The Canada del Oro, northwest of Tucson, Ariz., is reported to be the scene of extensive prospecting for placer gold. Over 3,000 acres are being tested out by William M. Neal, of San Francisco, who is said to have an option on ground that has been panned and sluiced for gold ever since the days of the Spaniards.

Tonopah Production Normal

Bullion production by the Tonopah, Nevada, mining district indicates normal operations for August and September. August bullion was valued at $168,000. The Tonopah Mining Co. shipped $95,800, which includes the production of the Tonopah Belmont Development Co. and some miscellaneous custom lots from various sources; the Tonopah Extension shipped $41,000, and the West End $31,000. Custom ore from Goldfield, Gilbert, Divide, Clifford, and other small outside camps during the month was not an important factor in the bullion production.

No new discoveries of importance were reported during the month of August, and mine conditions remain practically unchanged. The decline in the price of silver is of import to the district, as most of the ore milled is low in grade, and the margin of profit small.

White Caps Encounters Ore on Lower Level

In the White Caps mine, at Manhattan, Nev., the north crosscut has entered ore on the 1,310 level. This crosscut had previously cut a narrow streak, which carried good values, with a nonconformable strike and dip. As the crosscut advanced the ore widened, until at present the face shows five feet of ore which will average about $45 per ton. This ore is not regarded as the main oreshoot, but it may prove to be an extension from the main shoot developed on upper levels.

U. S. Midvale Flotation Mill Increases Capacity

The new flotation mill of the United States Smelting, Refining and Mining Co., Midvale, Utah, is being enlarged by the addition of new equipment including a rod mill, Dorr thickener, flotation cell and filter. By Nov. 15, the company expects to have the new unit operating which will give a capacity of 800 tons daily as compared to 650 tons at present.

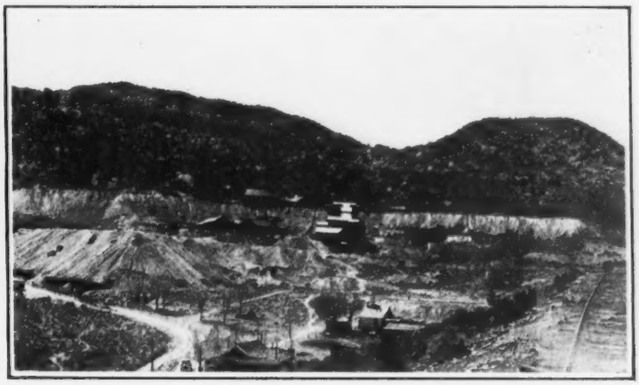
New Railroad Will Provide Outlet for Kofa District

The proposed new line of the Southern Pacific, which will pass through Phoenix and connect with the present main line in the vicinity of Dome, Ariz., will provide an outlet for many Yuma County mines which have remained dormant for a number of years. In the Kofa district, the Katheryn, a silver-lead producer, owned by San Bernardino capitalists, is preparing to ship ore. The ore assays around $20 per ton, but hitherto this class of ore has had to be considered non-commercial, for the reason that transportation from the mine to the present line railroad cost approximately $20 a ton. The building of the new line will reduce this charge to about $4, as the railroad will be within 30 miles of the mine, and eliminates the necessity of freighting the ore across the Gila River. A mill is soon to be built at the property, according to A. B. Saling, who is in charge at the mine.

Kay Copper Reports Progress

Work at the Kay mine, Canon, Ariz., is reported to be progressing satisfactorily. The west or original orebody has now been developed over a length of 210 ft. on the 1,500 level. On the same level the east orebody has been developed over a length of 150 ft., with the southern limits not yet reached. The main raise from the 1,200 level is now within 135 ft. of the 600 south drift of the old workings and should be completed to a connection within six weeks.

Surface plant of the Bristol Silver mine, Pioche, Nevada



Combined Metals mine, Pioche, Nevada

New Comstock Mining Co. Reorganized

The New Comstock Mining Co., Kingman, Ariz., former owner of the Katherine gold mine, in Mohave County, Ariz., has received permission from the Corporation Commission to issue 1,494,248 shares of the capital stock of the reorganized company, known as the New Comstock Mining Corporation, to stockholders of the original company. The new company was organized after the expiration, by limitation, of its original charter, issued twenty-five years ago. The company has a very promising gold property in the northern part of the state.

Butte Hill Copper Resumes Shaft Sinking

Since unwatering the 200 level at the properties of the Butte Hill Copper Co., the shaft has been sunk an additional 70 ft., with the 500-ft. point as objective. Properties are north of Walkerville, Mont., and are being financed by Dr. Maurice Eisenberg and New York associates.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Teck-Hughes Has New Oreshoot —Lake Shore Mills 540 Tons Daily

At the Teck-Hughes mine, of Kirkland Lake, a new oreshoot has been found in the No. 3 vein on the 12th level. This discovery was made west of the diabase dike which cuts the property in a north and south direction about midway between the Teck-Hughes shaft and the boundary line of the Kirkland Lake Gold Mines. The oreshoot has been opened for a length of 150 ft., with the face still in ore. It has not yet been developed on either the 11th or 13th level and may prove to be an important addition to the ore reserves.

The big new orebody which has been developed during the last year lies to the south of the No. 3, and although considerable work has been done this ore has not been found west of the diabase. Within the next week or two shaft sinking will again be started, the objective being 2,250 ft., which will mean the opening up of six new levels. This ground has been explored by vertical diamond-drill holes below the 13th level, which reached a depth of 2,400 ft. from the surface. Although no report has been issued regarding this work, it is known that the management was quite satisfied with the results. Good progress is being made with the mill construction and the structural steel work is now being erected. The first unit of the new mill should be in operation by the beginning of next year.

The Lake Shore mine, of Kirkland, is starting to sink the main shaft from the 1,000 to the 1,600 level. At the same time a 600-ft. winze will be sunk from the 1,000 level on the No. 2 or north vein, the main shaft being on the south vein. The Lake Shore carries its levels 200 ft. apart, and this will permit of opening up three new levels. The company is putting up a new building to house an experimental plant, in which flotation and table concentrating will be tried out. Kirkland ores contain appreciable amounts of tellurides, and it is possible that with additional depth the copper content of the ores may increase. The opinion has been expressed that operators in the Kirkland camp may eventually come to water concentration, before cyanide. The Lake Shore mill is treating approximately 540 tons a day, and this will shortly be stepped up to about 600 tons a day.

Ontario Gold Production Increased in August

The monthly report of the Ontario Bureau of Mines covering the gold production for the month of August shows a total of $2,670,150 as compared with $2,263,023 in the previous month. Up to the end of August the total production amounts to $20,579,399, an increase of $1,400,000 compared with the previous year. During August 337,019 tons of ore was milled, the average recovery being $7.93. In the Porcupine camp 293,477 tons was milled, the recovery being $2,032,226, an average of $6.93 a ton. In Kirkland Lake 43,543 tons was treated, the recovery being $637,924, an average of $14.66 a ton.

Dome directors have declared the regular quarterly dividend of 50c. a share, payable Oct. 20, to shareholders of record Sept. 30. This declaration sets at rest for the time being rumors of a possible dividend cut. It is believed that no action in this respect will be taken until the annual meeting of the shareholders, to be held some time next spring, when the shareholders will probably be asked to decide the matter.

The annual report of the Lake Shore Mines, Kirkland Lake, for the year ending June 30, shows that a total of 125,676 tons of ore was treated and bullion to the value of $2,235,184 recovered, or an average of $17.79 a ton. The tonnage milled was an increase of approximately 30 per cent and the bullion produced showed an increase of $423,000. Total income for the year was $2,245,971. During the year dividends amounting to 35 per cent, or $700,000, were paid. Broken ore reserves show substantial increase and now amount to 181,535 tons, valued at $4,346,799. No other estimate of ore reserves is given.

Wright-Hargreaves Expands Development Program

The Wright-Hargreaves, operating in the Kirkland Lake area, Ontario, has ordered a new twenty-drill compressor which it is hoped to put into operation within two months. This will enable development to be carried on more actively by the opening up of new faces of ore.

Cages are now running through from the surface to the 1,250 level in the old main shaft on the No. 2 vein. The new flotation process is working very satisfactorily in the separating of the tellurides. It gives a more efficient recovery and less cyanide is necessary.

At present the Wright-Hargreaves is the largest producer in the Kirkland Lake camp, the output having been substantially increased by the rich ore encountered at depth.

With the resumption of shaft sinking at the Telluride property, at Kirkland Lake, metallurgical tests will be made to determine the most economical process of concentration. The tellurides carry quite a proportion of the gold. The ore also shows gold in the free state, good silver values, and a high percentage of copper.

Consolidated West Dome Encounters New Ore Shoot

The position of the Consolidated West Dome Lake Mines, Ltd., Porcupine, Ontario, has been greatly improved during the last few weeks by the opening of a vein recently encountered on the 1,050 ft. level. The new ore shoot was encountered to the east toward the Dome mines. It has been drifted on for 200 ft. and is still in ore. The vein shows a width of from 7 to 9 ft. and average assays show values of about $9. This shoot is still to be located on the higher levels. The only development work at present under way is on this 1,050-ft. level, and it will likely take about 3 months' work to determine its extent.

Kootenays Chief Center of British Columbia Mining Operations

The Kootenays still retain their place as the chief center of mining activity in British Columbia, as is shown by the large increase in the amount of ores and concentrates received at the Trail smelter. Receipts for the present year up to Sept. 7 amounted to 392,608 tons, or 1,002 more tons than was received at the smelter during the whole of 1925. Besides the Consolidated Mining & Smelting Company of Canada's group of mines, 92 independently owned mines contributed to this total. Twenty independent mines each shipped more than 500 tons, the largest independent shipper being the Allenby Copper Corporation, with 22,693 tons of copper concentrate. The two years—this and last—however, hardly are comparable, because the Consolidated company introduced its milling service during the latter half of 1925, and a considerable proportion of the tonnage received from independent operators during this year has been milling ore. The service has been exceedingly popular among mine owners, several of whom have closed their own mills because so much better results were obtained by the custom mill at Trail, which is operated by thoroughly trained men. The service has made possible, too, the shipment of lead-zinc ores by mine owners that had no mill, and but for the custom mill such ore could not have been shipped profitably.

Paradise Mine, in British Columbia, Bonded

A group of Ontario capitalists has bonded the Paradise mine and the White Cat group, situated in the Windermere mining division. It is understood that the consideration is around $450,000. The Paradise is owned by Randolph Bruce, Lieutenant-Governor of British Columbia, and for many years has been a steady shipper, sending 800 to 1,500 tons of smelting ore annually to Trail. The White Cat is a promising prospect, owned by the Galena Ghat Mining Co., of Alberta, the ore of which is a clean galena without any sphalerite.

Premier Pays 8 per Cent Dividend

The Premier Gold Mining Co., Premier, B. C., has declared a dividend of 8 per cent, amounting to $400,000, covering operations for the third quarter of this year. This brings the total disbursement to date up to $9,403,375. The first dividend was paid in December, 1921. The capitalization of the company is $5,000,000. The company has been able to maintain its dividend rate by greatly increasing its output of ore, this being necessary, as the ore in the deeper levels is far poorer than that found in the upper ones. Recently the company has taken an option on some silver-gold-lead-zinc deposits in the Marmot River section of the Portland Canal division, and for some time it has been exploring the Cantu group, situated on the Alaskan side of the international boundary.

London Letter

By W. A. Doman

Special Correspondent

New Modderfontein Reserves 9,289,000 Tons—Tanganyika Goldfields May Be Tin Mine

London, Sept. 14—The New Modderfontein Gold Mine, which is one of the world's largest producers, continues to make excellent progress. Crushing with only 10 stamps commenced in 1892, but the plant has been steadily increased and for the past financial year the record quantity of 1,532,000 tons of ore was treated. The profit of £2,037,575 also constitutes a record and it is satisfactory to note that owing to closer sorting and cleaner mining the yield per ton of 10.243 dwt. is higher than for years past. Working costs have increased 9d. per ton to 17s. 10d. this being due to additional expenditure on underground equipment and sand filling. Despite the huge extraction of ore in past years the mine has still an estimated life of about 13 years at the current rate of working, while the ore reserves have increased to 9,289,800 tons or more than 6 years' supply. Owing to greater efficiency and the extended use of jackhammers it has been possible to reduce the stoping width and thus the average value of these reserves is 0.1 dwt. higher than a year previously at 8.6 dwt. It will be noted that the actual yield is much above this figure.

Like those of many other Rhodesian mines, the ore bodies of the Gaika Gold Mine are very erratic in their occurrence, and until a year or so ago it was thought that the future of the property depended entirely upon development at depth. The mine manager, A. M. Macilligan, M.I.M.M., and the consulting engineer, R. R. Johnson, A.R.S.M., M.I.M.M., however, decided a year or so ago upon a program of intensive development of the upper levels as there was still a very big area unexplored. This has proved very satisfactory and when it is remembered that development costs in these levels are only 33.1 shillings per foot, as compared with 116.4 shillings per foot in the lower levels (including sinking of internal shafts) it will be seen that, given reasonable values, the upper levels must prove much more profitable to work. The latest discovery in the third level in virgin ground is an entirely new reef, which although only driven on for 15 ft. gives values of from 23 dwt. over 84 in. up to 44 dwt. over the same width. These figures compare with 9.2 dwt., the value of the ore reserves, and, if persistent, should greatly improve the fortunes of the company.

There is considerable talk in the market here of the Tanganyika Goldfields, not so much because of its possibilities as a gold and diamond producer, but as the owner of a potential new tin field. The 5s. shares have risen from 5s. to 10s. in a few weeks. Options have been secured over about 900 square miles on the western side of Lake Victoria and three engineers are reported to have located on two areas several hundred tons of alluvial tin, samples of which have been assayed in London and found to contain 72.5 per cent tin. Private advices are to the effect that transport presents no special difficulties, while water and labor are plentiful. The reports have reached Nigeria and Johannesburg and I understand engineers from both centers are on their way to the district. No new tin fields have been discovered for years and in view of the statistical position of the metal developments will be watched with keen interest.

Canadian Talc and Soapstone Production 28 per Cent Higher in 1925

According to the Dominion Bureau of Statistics at Ottawa, there was an appreciable advance in the production of talc and soapstone in Canada during 1925. Shipments totalled 14,474 tons valued at $205,835 in 1925 as against 11,332 tons at $154,480 in 1924. The seven firms operating in this industry in Canada reported a capital investment of $744,037 in 1925. Employment was furnished 10 salaried employees and 82 wage-earners.

Exports to the U. S. from Belgian Congo Increase

Shipments from the Belgian Congo and the Rhodesias to the United States during the first half of 1926 show a remarkable increase over those for the corresponding period of last year, according to the Department of Commerce. Declared exports from these two regions to the United States during the first six months of 1926 show copper from the Belgian Congo aggregated 50,002,000 pounds valued at $6,079,000, as against totals for the 1925 period of 2,236,584 pounds and $279,573. Other mineral products brought the 1926 half-year total value of Rhodesian and Belgian Congo exports, declared through the Union to the United States, to $6,357,000, as against the 1925 six-month total of $656,836.

Cold Lake, Manitoba, Has Extensive Deposits of Copper-Zinc Ore

Professor R. C. Wallace, of Manitoba University, has returned from an investigation of the copper-zinc deposits in the Cold Lake area 45 miles northeast of the Flin Flon copper mine, in northern Manitoba. He states that so far as diamond drilling has gone it shows that the orebody is on the whole richer than that of the Flin Flon, and that the discovery is one of the most important made in the northern territory during recent years. It is of sufficient consequence to justify extension of the prospecting area much further north than previous prospecting indicated. The area between this property and the Flin Flon, especially the southern half, will now be intensively prospected for copper-zinc as a direct result of the development work that has been done.

Paris Letter

By Francis Miltoun Mansfield

Special Correspondent

Italy Conserving Lead and Zinc Ores for Domestic Consumption

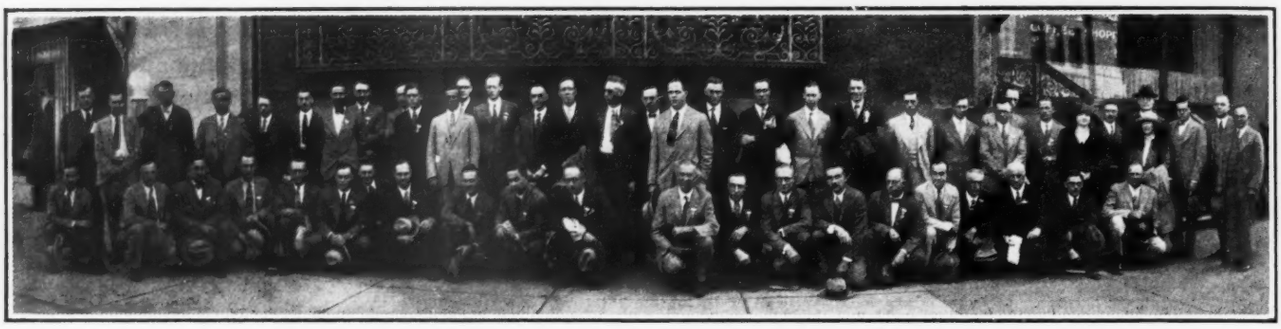
Paris, Sept. 12—The financial and industrial echoes within the Italian parliament in November of last year brought about the promulgation of a decree whereby all future mining concessions must first be submitted to the Minister of National Economy for authorization. With the general industrial revival which began in Italy in 1923 foreign mining companies were obtaining concessions and absorbing others which had previously been in Italian hands. Penarroya, Crown-spelter, Vielle-Montagne and other French, British and Belgian companies were forcing their way in and an Italo-American group, controlled by the Mining and Development Corporation of New York, absorbed the former Raibl and Predil mines of the Tarvis Pass.

Italian reduction plants were handling but 25 per cent of the output of lead ore, the remainder being exported to France and Belgium or handled by the Pertusola plant at Spezzia, a former British organization which had been absorbed by the alien Penarroya. The lead metal thus available for Italian consumption, without having passed through foreign hands, was but one-tenth of the normal annual demand. The situation for zinc was on the basis of but 15 per cent of production being worked or delivered to home consumption, the balance being exported to Belgium and Germany. Italy consumes 16,000 tons of the metal.

Italy's production of lead ore was considerably greater in 1925 than in the year before the war. From 1923 to 1925 production increased from 37,000 to 51,360 tons, while that of Sardinia rose from 34,000 to 46,200 tons. Imports of mineral, particularly from Tunisia, in 1925 were but half of what they were in the previous year and below the pre-war figures. With the increase in smelting plants within Italy itself, lead ore was exported in 1925 to the extent of but 12,720 tons.

Zinc ore in 1925 finds its output nearly doubled in four years, having increased from 95,000 tons in 1922 to 177,000 tons in 1925. Sardinia furnished the bulk, 116,000 tons out of the total. The Friuol deposit, exploited by the Italian-American interests, produced 34,500 tons. Imports of zinc metal and semi-finished or finished products amounted to 25,000 tons in 1925, an increase of fifty per cent above the year before, the United States having accounted for more than eight thousand tons, followed by France and Belgium with 2,800 tons each.

The Ministerial Committee of Experts, at the head of which is Professor Perier, chief of the geological bureau, is of the opinion that within two years Italy may become independent of foreign imports of lead, zinc and aluminum so far as its interior consumption is concerned.



Denver's Mining Congress a Success

Important Topics and Prominent Speakers Mark Program—The Public Lands Question—Silver and Its Future—Ore Finding—The Future Supply of Minerals

By A. H. Hubbell
Managing Editor

ONE of the most successful mining conventions in recent years was the Western States Joint Convention, held at Denver on Sept. 20 to 23. Four organizations cooperated—the Western Division of the American Mining Congress; the American Institute of Mining and Metallurgical Engineers; the American Silver Producers' Association; and the American Association of Petroleum Geologists. An excellent program was provided, a program leisurely enough to permit its full enjoyment. Only topics of current interest were included and some of these were of great importance. The speakers were well selected—the comparative brevity of the program made this possible. Attendance at every session was large.

Denver's newest hotel—the Cosmopolitan—was the place of meeting. The weather was Denver's best. Denver's mining men were hospitable, as always. In all things, Denver lived up to its reputation as a convention city.

Public Lands a Live Topic

Strong sentiment in the West against the present Federal Government in the disposal and administration of the public lands remaining within the boundaries of the eleven public land states developed at the opening session. Four prominent speakers had place on the program arranged by the Western Division of the American Mining Congress. Jesse F. McDonald, governor of the Colorado Chapter and at one time Governor of the state, presided. Two of the speakers, Governor George Dern, of Utah, and Congressman Charles E. Winter, of Wyoming, presented a view which seems to reflect the general feeling in the West. The Federal Government's side was supported by the Secretary of the Interior, Hon. Hubert Work, and the Commissioner of the General Land Office, Hon. William Spry.

The West has a grievance, the remarks of Governor Dern and Representative Winter quickly made it plain. It does not like the present leasing law and will oppose any extension of it. It resents the collection of royalties from the public lands by a Federal landlord. It resents the discrimination between these Eastern states, the public lands of which were long since disposed of and which are now a source of revenue to them through taxation, and those Western states wherein vast areas, it seems, are to be kept forever from coming under state control, and thereby becoming subject to state taxation. The Western states feel that, in this respect, they are not sovereign states within their respective boundaries. They feel that it is unjust that land within their borders should be held and administered "for the common good" of all the states, including New York and Pennsylvania. It may be that Western sentiment in these respects is not yet sharply crystallized, but it is evident from the addresses made and the way they were received, that public opinion is gradually forming, and by some the matter is expected to soon become a political issue.

The Federal Government can well continue to administer the national forests as a service in return for taxes paid, the oninion has been expressed. But its seeming strong reluctance to pass title to public land under any circumstances, if it can possibly prevent it, is contrasted unfavorably with its former attitude when it was eager to get the land settled and the mineral wealth developed. Then, the only question was whether the law had been complied with.

Governor Dern dealt with the subject from a local viewpoint, talking specifically on school land titles in his state of Utah. Representative Winter's speech expressed what was, perhaps, a rather extreme view of the situation in the West in general and in Wyoming in particular.

The School Land Problem in Utah

When Utah became a state, four sections in each township within its borders were granted it, by the enabling act, for the support of common schools. This, said Governor Dern, would have yielded substantial revenue for the schools without a crushing burden of taxation. But, after the passage of the enabling act and the adoption of the constitution, the Federal Government began to undo the work of Congress by claiming that the lands known to be chiefly valuable for mineral had not been included in the grants. It took the position that, while the enabling act did not specifically reserve minerals, neither did it specifically grant them, and that, therefore, they were reserved. This, said Governor Dern, was the beginning of Utah's school land problem, over which it has been sweating ever since.

No Special Favors Asked

"What we want is that Congress shall confirm its original grants so that we may have what was originally given us, mineral and all," said the Governor. "In asking this, we are not asking for special favors that other states have not received." Other states, including Michigan and Minnesota, which were admitted under enabling acts containing almost the identical language of the Utah act, had received and kept their minerals. Michigan had got the great copper and iron mines found in her school sections. Minnesota had got the iron mines, and the revenue from mineral, timber and agricultural lands had now created a trust fund of $57,000,000. Oklahoma had collected in 1925, in bonuses, rentals and royalties from her mineral lands which belong to the state, $991,000, and had built up a fund of nearly $9,000,000 from this source.

In Utah, they were just as good conservationists as the national government, said Governor Dern. The state had a mineral land leasing law under which all minerals in state lands were reserved to the state, and when it sold a piece of land, it sold only the surface. This, he pointed out, showed that the Federal Government could not justify its course on the ground that it was saving natural resources from the spoiler.

The Federal Government had made matters worse by its rule of geological inference, whereby, if a vein of coal were exposed on the side of a mountain, all lands into which the vein might extend were considered coal land

and, therefore, were reserved. However, although it took lands away from the state by such geological inference, it would not let the locator of a claim get a patent on geological inference; instead, he must have the mineral in place. Other technicalities which were turned to advantage by the Federal Government in order to take away from the state the minerals on the school sections in each township were cited by Governor Dern. Further, as a result of the contests instituted by the Government, the state was involved in endless hearings in which the Federal Government was at once prosecutor, judge and jury. And where the state had sold a school section, the purchaser could not be sure of a valid title, for at any time the Federal Government might challenge it on the ground that the land was mineral.

Governor Dern said that he endorsed the doctrine that state sovereignty is the nation's strength, as outlined by President Coolidge in Denver, as well as the doctrine that strong states are vital factors in our national policy, uttered by the Governor of Maryland last April. "It is refreshing to us Westerners to hear these wise words coming out of the East," said Governor Dern. "Let us hope that they will be backed up by actions that will give the public land states of the West a little more sovereignty and a little more of the local self-government which the President lauds as our chief treasure. The people of Utah would be glad if they could exercise sovereignty over the land within the boundaries of their state . . . three-fourths of its area belongs to the Federal Government. The situation is similar in all the Western states. In Arizona, 67 per cent of the area of the state is still in Federal control; in New Mexico, 43 per cent; in Idaho, 67 per cent; and in Nevada, 87 per cent. We are not sovereign states, but are under the paternalistic control of Uncle Sam in a very important degree."

As the Wyoming Representative Sees It

Describing the public land situation as he saw it, Congressman Winter said that of the unreserved and unappropriated public lands, only 184,000,000 acres was left—naturally the poorest of all the country's lands. Ninety-seven per cent of this was in the eleven Western states. The acreage permanently withdrawn from acquirement by private ownership and forever reserved was, in round numbers, 200,000,000 acres. Since there was a well-defined movement to place the 184,000,000 acres of unreserved land above referred to on lease or rental, or grazing fee system, the country was face to face, he said, with the question as to whether not only the areas heretofore reserved but also this additional acreage was never to pass to private ownership, or be made taxable, but was to remain under the Federal Government as a perpetual landlord. He was utterly opposed to this idea. This area was equal to 55 per cent of the total area of the eleven Western states. These states, he said, could not develop and live, half state and half national, as to their land areas.

The international treaties, the ordinances of 1887 and the Constitution, said Mr. Winter, all expressly provided that the areas acquired from Great Britain, Spain, France and Mexico should be formed into free independent states, upon an equal footing with the thirteen original states, but the eleven public land states had not been and were not now upon an equal footing with the thirteen original states, nor could they ever be if Federal control were to continue indefinitely and increase, instead of diminishing.

It was commonly thought and said that the public lands and their resources were for "the common benefit of all the states," said Mr. Winter, "but anyone would look in vain for any such provision in the Constitution. Referring to the leasing act, he said that it had been opposed by the West until the West had been overwhelmed by Eastern numerical strength in Congress. He was opposed, he said, to Government regulation of the remaining, unreserved public domain on the ground that it would prevent entry and settlement of the great areas in the public land states and that it would reverse the steady policy of the Government, which, under the Constitution, was to dispose of these lands to make homes and build up the states.

The mineral leasing law should be repealed, Representative Winter suggested, in closing, and the country should proceed, as before, under the general mining law, with such amendments as might be necessary to meet conditions of today. If the leasing law could not be repealed, inclusion of other and additional minerals under it should be resisted. The title to all school land sections should be settled now and confirmed in the respective states, he urged. All legislation should be consistently pressed which should tend to bring all lands with their resources, except national parks and monuments, into state or private ownership, development and taxation. The Federal Government should be retired, after 140 years, from the land business!

Secretary Work Explains

Explanation of the Federal Government's attitude towards the public lands was made by Secretary Work. It was not his purpose to forecast the action of Congress, he said, or to advocate a reversal of the Government's present policy, in its entirety, but to open the subject for discussion.

The lands of the remaining public domain were no longer valuable for agricultural purposes, the Secretary said, but the national land laws had not been revised to meet these changed conditions. Yet citizens were still being invited to waste their time and savings in a fruitless enterprise. However, the principal value of the remaining public domain was in its mineral contents. The Federal Government was now co-operating in the discovery of these ores. The mineral leasing act passed in 1920 assumed that the people hold a continuing interest in the country's natural resources, and so the rights were leased instead of sold. The act, of course, did not apply to the mining of gold, silver, copper, lead and zinc and other metalliferous ores. Of the royalties, 37½ per cent and 5 per cent of the net proceeds from the sale of public lands were turned back to the governments of the states in which the lands are located; 52½ per cent of the royalties and about 60 per cent of the receipts from sale of lands went into the Reclamation Fund to be used in the West, while only 10 and 35 per cent, respectively, reverted to the U. S. Treasury.

Outspoken demands had been made, said Dr. Work, that publicly owned lands should be "returned" to the states in which they are located. These lands had never been owned by the states and so had never been taken from them. In 1787, the Confederate Congress passed an ordinance declaring that "the legislatures of those districts, or new states, shall never interfere with the primary disposal of the soil by the United States in Congress assembled, nor with any regulations Congress may find necessary for securing the title of such soil to bona-fide purchasers."

Questions State Administration

He was convinced, the Secretary said, that the Federal Government was administering more, and the state less, of the activities of Government than it should. But what would become of the public lands and their resources if administered by the states? What had become of public lands already returned to them? Which would be the least vulnerable to local influence—the Federal Government or the state? How many of the newer states could actually afford to own and administer the public lands within their borders?

"Whether there should be a fundamental change of policy involving this great public trust is a question of national importance, and not alone of local interest," said Dr. Work. "The outright gift of the minerals in the school lands granted to the states means a permanent release by the United States of natural resources that belong to all the people of the country. No right or claim of the states seems to justify the gift of those minerals and only Congress is vested with the power to give them away.

"Unlike the mineral leasing law covering non-metalliferous minerals and under which the minerals remain the property of the United States, the Federal mining laws provide for the disposition of the land itself, as well as the minerals found in it. I know of no valid reason for changing these statutes," said the Secretary. "It has been claimed that the fact that no notice is given the General Land Office of a mining location often leads to conflicts with homestead and other filings. No insurmountable difficulties, however, have been encountered in equitably adjusting them."

Commissioner Spry Blunt

The states had not, as a rule, said Commissioner Spry, conserved their school grants, except where Congress

had placed a rigid condition on their disposal. His speech dealt with the topic of "Leasing of Public Domain." Addressing himself in closing directly to the people and officials of the mineral public land states, the Commissioner said:

"Statehood, with its benefits and responsibilities, was not forced upon you, but granted at your request. Your present demands that you be given the mineral school sections is a repudiation of your solemn acceptance of the grants. The mineral lands do not belong to you and never did. The public lands were acquired (by the Federal Government) by gift of the older states, by purchase, and by the blood of our sons. No public land state has added an acre to our flag."

American Silver Producers Meet

India Disturbs the Situation

No topic of greater interest than that of silver and its future can be broached in Colorado. It fell to the lot of the first vice-president of the American Smelting & Refining Co., F. H. Brownell, to talk on this popular subject at the open meeting of the American Silver Producers' Association, on Tuesday morning. Mr. Brownell had much to say and said it forcefully. "What Can Be Done for Silver?" was his theme. Everything was rosy in the silver industry until recently, he told the audience. The average price of the metal last year was more than 69c. per ounce and a continuance of this fairly comfortable position in 1926 seemed likely. But rumors of a disturbing sort had been heard, namely that India, the industry's largest customer, was considering the advantages of gold as standard, instead of silver. Not only that, but India, the world's greatest sink of silver since ancient days, was thinking—that is, a certain influential element there apparently was thinking—how much better it would be if the native masses would learn to open bank accounts, instead of hoarding silver. India suddenly loomed as a possible seller of silver in large quantities, instead of as a purchaser. As a result today the metal was selling for 61 and a fraction cents per ounce, he said.

This drop, said Mr. Brownell, was generally believed to be largely due to the report of the so-called Royal Commission on Indian Currency and Finance to the effect that sentiment in India was strongly in favor of the changes mentioned. During the war and since, India had suffered from the fluctuating value of the rupee, which, as bullion, had at times been worth more than its denomination. This had led to the demand for redemption of paper rupees in silver. At the same time, the balance of trade had gone heavily in the country's favor. Thus had come the crisis, to meet which, the mother country, England, had debased her coinage and, besides, had bought from the United States 200,000,000 oz. of silver, a purchase made possible through the Pittman Act—all this to get the silver needed for aiding India. Then, after this, had come the further crisis of 1920, when the price of the metal fell disturbingly. Because of this chain of events and to avoid similar occurrences, the Royal Commission mentioned had been appointed.

To the Commission had been submitted a plan, continued Mr. Brownell, that had for its chief object the dethroning of the rupee as a standard coin of unlimited legal tender, thus to remove the threat to currency from the possibility of a rise in the price of silver, and to cure the people of their habit of hoarding and to develop in them, through the medium of gold currency, a faith in banks and banking. China and India never had taken to banking but held their savings in actual gold and silver. There, however, the essentials for the development of a modern banking system were lacking, said Mr. Brownell. Such savings as the masses individually could make were so minute that silver and not gold was the necessary medium for saving, and banking was impracticable. Thus it was that Asia had been and was the greatest consumer of silver.

Substitute Plan Adopted

The Commission, after holding hearings in India and London, had adopted a modified substitute for the original plan, one allowing more time for acquiring a gold reserve and for disposing of the silver. This substitute provided that the paper rupee should no longer be convertible into the silver rupee; that substitution of paper for silver rupees should be encouraged; that silver holdings in India should be converted into gold bars or more economic forms of savings; and that not only ought the Indian Government to buy no more silver for coining into rupees, but that it should sell over a ten-year period a large part of its present stock.

But India could place about 700,000,000 oz. on the market in the next ten years, it appeared, or three times the world's output and ten times that of the United States. Who would buy this? asked Mr. Brownell. Also, who would buy the silver that India used to buy? The effect could not be but to lower the price of silver, with a corresponding world-wide rise in the price of gold, the latter accompanied by an era of falling prices, when creditors would gain and debtors lose. The decrease in price would mean an enormous loss to holders of silver and it would, at the same time, increase the amount which the world would have to pay for copper, lead and zinc, the ores of which generally contain silver as a byproduct.

Remedies, If Any

"What, therefore, can be done for silver?" asked Mr. Brownell, coming finally to the topic of his speech. Three things, he said: Prevent India's threatened action; foster resumption of subsidiary coinage in Europe as currencies of various nations become stabilized; and carry on propaganda for increasing the use of silver in the arts.

"What is primarily needed is a retention in India of the exchangeability of paper rupees for silver rupees and a decision not to sell any portion of its present holdings of silver by the Indian Government," he said. Some, especially those abroad, may think that Mr. Brownell flattered the United States too much when he continued in the following words:

"If the United States, through its Treasury Department and Federal Reserve Bank, aided by the great banking houses of the United States, strongly urges that this course be taken, it is probable that it will be done. . . .

"It is very proper," he said, "that in consideration of the change in India's policy which the United States desires, it should agree that, whenever an emergency arises, it will sell silver to India or to the British Government at a price below the melting point of the silver rupee . . . and every mining company in the United States should and would contract and agree with our Government that, in case of any such emergency, the silver produced by it would be sold at a price to be fixed by our Government, not higher than the melting point of the silver rupee and not less than, say 70 to 75c. per ounce. Such an agreement might be entered into for a period of ten or twenty years as might be desired. During that time, advances will be made in the reconstruction of European currencies and time will be given to work out a system of Indian currency without injury to silver."

If the proposed sale of Indian silver, said Mr. Brownell, be based upon the desire to get the money for purchasing gold to establish the so-called "Gold Bullion Standard," recommended by the Commission, this gold could be obtained by issuing bonds, which, if approved by the U. S. Government, would be readily purchased here. As for preventing hoarding, he said, would not the people of India all the more demand gold for hoarding purposes? "And where is the gold to come from?"

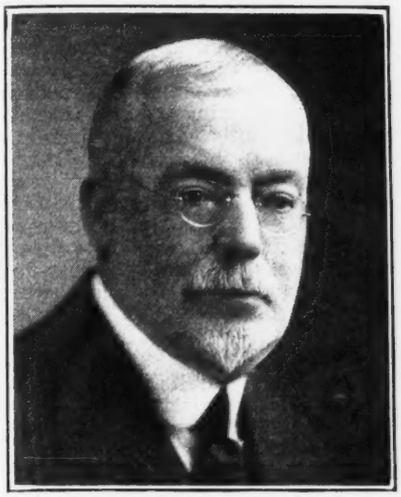
Administration of the Pittman Act Reviewed

W. Mont Ferry, of Salt Lake City, presided at this meeting. After Mr. Brownell had ceased, Mr. Ferry introduced Ex-Senator Charles S. Thomas, whose topic also dealt with silver, "The Administration of the Pittman Bill."

Senator Thomas began by referring to the addresses of Secretary Work and Commissioner Spry on "Public Lands" the day before. These gentlemen, he said, recognized the supreme importance of administering the laws as they found them. Such officials should be upheld in these degenerate days. Now it was his duty, the Senator continued, to show some results of failure to administer the law as one found it, official discretion being substituted for the law instead. In this he had reference to Under-Secretary Gilbert, who, it will be recalled, revoked the allocations of silver for subsidiary coinage under the Pittman Act, wherein, it is alleged, he violated the express provisions of the Act.

Starting with Jan. 1, 1918, the speaker then told how, on that date, there was in the Treasury vaults $600,000,000 in silver dollars, or silver bullion, covering silver certificates in circulation throughout the country—the only great reserve of silver in the world at that time. The United States had already entered the war. Great Britain, needing silver to prevent disaster to

Prominent Speakers at the Denver Meeting



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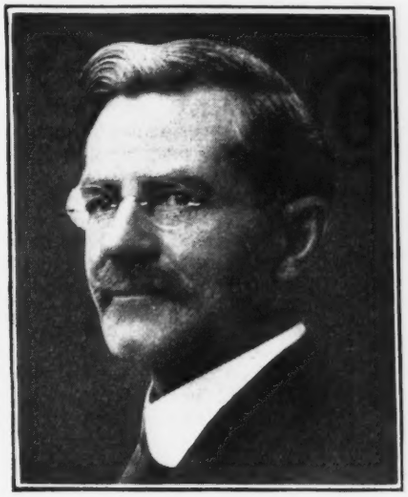

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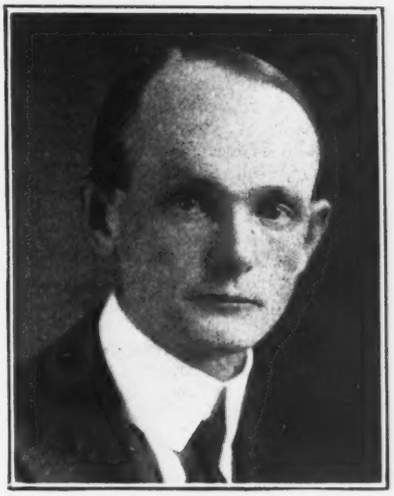
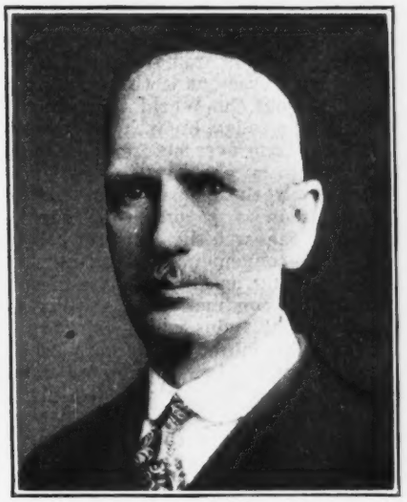


H. Foster Bain

Francis H. Brownell



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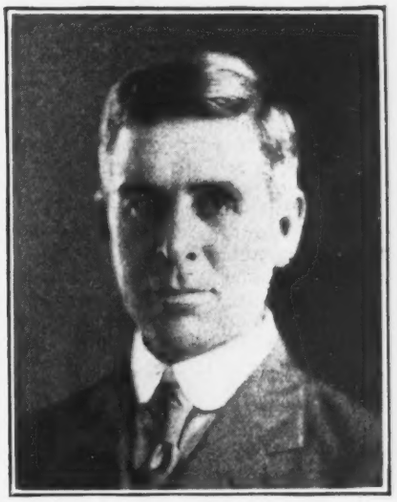

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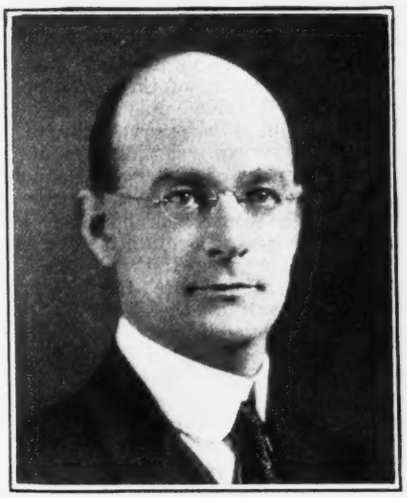

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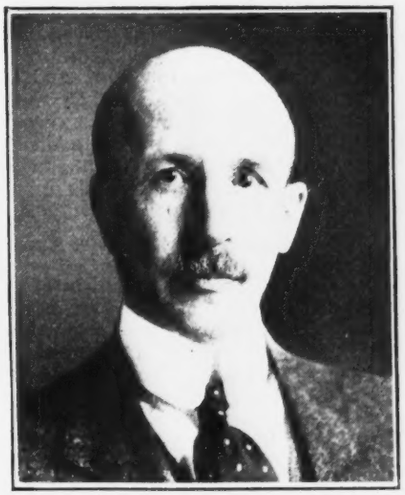


W. C. Mendenhall

S. A. Taylor

its Indian Empire and the collapse of its Mesopotamian campaign, approached the United States Government and the passage of the Pittman Act resulted. One of the four purposes for which this act was passed was to provide subsidiary coinage, this being put into the act at the express urging of the Secretary of the Treasury. To make sure that silver so used might be repurchased, said Senator Thomas, Senator Pittman inserted a clause stipulating that the disposition of silver for this purpose should be regarded as a sale. Of the dollars melted, 200,000,000 oz. was sold to Great Britain. Of the balance, about 14,000,000 oz. was allocated to the Director of the Mint and, in each such sale, an order was incorporated to the Director to buy an equal amount from American producers at $1 per ounce.

The administration of the law continued down to December, 1920. Of the allocated silver nearly 11,000,000 oz. was actually minted into subsidiary coins. In January, 1922, the story continued, the coinage of fractional currency was suspended. Suddenly, in February, 1922, the Under Secretary issued an order canceling allocations of silver unused—about 4,000,000 oz. This was not a secret order but one not given wide publicity. In November, the Under Secretary, said Senator Thomas, addressed the Attorney General, seeking an opinion and concealing certain facts and misrepresenting others. Receiving a favorable reply, he issued an order canceling all the other allocations. Later, the Treasury issued a statement as to how much silver remained to be repurchased and the amount was found to be about 15,000,000 oz. short. The Under Secretary claimed the allocations were not sales, but loans. This, Senator Thomas declared, was done simply because of the lower price of silver on the open market. It meant a loss of $5,000,000 to producers.

The Eastern Antipathy to Silver

Silver men went to the Treasury and called attention to this perversion of the law, asking that the law be adhered to. Curious were the reactions of the people to the word "silver," said the speaker. East of the Mississippi the term was anathema. Man had only to mention it to become anathema.

The Senator then traced the history of the Pittman silver repurchase bill that had finally been introduced. Early this December, at the next Congress, the committee would report it out. Far more than 15,000,000 oz. of silver really remained to be repurchased, he asserted. Records of the Mint showed that three times this amount was proper.

Lest he, a Democrat, be accused of partisanship in his statements, Senator Thomas reminded his audience that the incidents referred to had taken place in the Wilson Administration under the Secretaryship of Carter Glass. To offset this, though, he told how in 1919 and 1920 some 13,000,000 oz. of silver had been melted and sent to Shanghai at a profit to the Treasury, not done under the Pittman Act, but something that could have been done legally only under that act. There was no difference in the East between a Democrat and a Republican, he said, when it came to silver! In closing, he reasserted that the question was whether a Secretary or Under Secretary could interpret the law, the Pittman Act, as he saw fit and not in accordance with its provisions.

A.I.M.E. Has Interesting Session

The Future Demand for Minerals

A varied program occupied the sessions of the A.I.M.E. on Wednesday. The Institute's president, Samuel A. Taylor, first on the program, discussed certain aspects of the coal-mining industry. H. Foster Bain, secretary of the Institute, followed with a paper on the future demand for minerals. The world-wide rise in the standard of living in the last century had been accompanied by a great increase in the consumption of minerals—not only in the amount and variety, but in the quantity used per capita, said Dr. Bain. The demand would increase. In France and Germany alone, statistics showed an enormous potential consumption, and in other countries the possible demand was even greater. Could this potential demand be translated into actual consumption? asked Dr. Bain. Would the various peoples want such goods badly enough to work for them? Could the demand be satisfied, if aroused? To what extent would substitutes supplant minerals? Through motion pictures and through travel brought about the World War, he said, more people today knew how the other half lived than ever before. The knowledge had so spread that in the United States even the poorest had the use of conveniences beyond the reach of all save the wealthy in many other countries—conveniences resulting from and depending on our free use of minerals. Common man was already demanding that industry be so reorganized that he might have more of the world's goods. Dr. Bain cited many things to show that it was likely that the future demand for minerals could be satisfied. The question of reserves rested upon technology and economics—technology and price inextricably bound together. If the world would pay for them, the metals would be forthcoming.

Two trends in production, said Dr. Bain, were operating to relieve pressure on mines for new metal and for the stabilization of price. These were the accumulation of stocks *in use* of metals reclaimable after use; and the ability to make substitution. By re-use man's essential needs might in time be met with only small annual additions of virgin metal, said Dr. Bain. In the reduction of the loss of metals in use lay a great field of opportunity.

The Progress of Leaching

Dr. M. F. Coolbaugh, president of the Colorado School of Mines, sketched the progress of leaching and electrolytic metallurgy. When asked to speak on this subject, Dr. Coolbaugh said, he had not realized that the *Mining Congress Journal* had recently published a very complete study of it by Stuart Croasdale. Not all metallurgists believed in the same methods for treating. There were the pyrometallurgists and the hydrometallurgists. The greatest impetus to real competition of hydrometallurgy with pyrometallurgy had been given by the electrical engineer in the effort to get cheaper energy. Twenty-five years ago in Colorado a power plant had been built with the guarantee to produce 1 kw. per 100,000 B.t.u. Today a plant was producing 1 kw. with 17,000 B.t.u. Electricity was and undoubtedly would remain the best means for recovering metals: it could be used constantly, did not fluctuate, and gave cheap labor costs. It was cleanly and produced metals of very high grade. Dr. Coolbaugh said that he could see no reduction costs comparable in pyrometallurgy, where almost the same fuel was used as twenty-five years ago and where the slags were little improved.

Roasting of Increasing Importance

Leaching had had its beginning, he said, with gold and silver ores in cyaniding. Then, it had been the mechanical engineer who had come to help the metallurgist and who had devised the thickener, agitator, and the filter. It started chemists studying solutions and how to remove impurities. It was reasoned that if the precious metals could be thus recovered, why not other metals? The start had been made with oxidized ores. In the last ten years the method had spread to unoxidized ores. These required treatment before they could be leached. Roasting of sulphides before leaching was now held to be advantageous. Work on complex ores had progressed. It had been found that many compounds might be formed in roasting ores that would make them more insoluble than before. This had opened up a new line of study as to how these compounds might be avoided. Anaconda had found it necessary to roast at a low temperature and keep iron away while roasting; otherwise ferrites were formed that were very insoluble, especially in dilute acid. Old Dominion had come to the aid of the metallurgist in eliminating iron. But iron in the molecular state could not be eliminated. Experiments were now being made in Denver to effect roasting without forming these insoluble compounds, said Dr. Coolbaugh. It had been found that if the ore and the air for oxidation and the products of the roast all traveled in the same direction, the sulphur gases produced would lessen the formation of these insoluble compounds. If they did form, they would decompose before reaching the end. This type of roasting produced a large quantity of water-soluble sulphate in the upper part of the furnace. This could be controlled, however, he said, by introducing a quantity of raw sulphide ore toward the end of the roast, which afforded a temperature control preventing the forming of insoluble compounds.

Physical chemistry was likely to be the basis of future progress, said Dr. Coolbaugh. By applying what was known about catalysis the rate of roasting had been greatly increased. Working to this end needed the co-operation of the state and even laymen to provide sufficient funds.

Dr. Coolbaugh said that the suggestion that leaching could be applied to zinc ores and to copper had been ridiculed. But it had been done, and now in the last few years it had been applied to lead ores. What we would see in the next ten years was a matter for speculation. The leaching curve was on the upward trend. Pyrometallurgists must be on their toes or they would take second place in metallurgy.

Selective Flotation

"Selective Flotation" was the topic of A. J. Weinig, superintendent of the State Experimental Plant at the Colorado School of Mines. Metallurgy today, said Professor Weinig, was not afraid to go where science had not gone. It was interested in results and left the "why" to science. One latest capture was floation, an art of the greatest application. Flotation was primarily a selective process, he said. We had been trying to make it a bulk process, and as a result had been putting into the furnaces huge quantities of a barren product, iron. Bigger ratios of concentration and higher recoveries at reduced costs were now being obtained by eliminating the iron by the selective process. The flotation mills of the country were now handling 50,000,000 tons a year, a tonnage second only to the iron-ore blast-furnace tonnage, and the rate was steadily increasing. Its application to lead-zinc-iron ores had been successful, removing the iron and separating the lead and zinc, which had hitherto been thought very difficult. As a result a smaller number of lead blast furnaces were in use, though lead ore tonnage had increased. Zinc retorts, moreover, were using a 70-lb. charge instead of one of 50-lb. as a result of flotation. Many impurities, such as arsenic, had been removed in the hydrometallurgy of zinc, so that a stronger acid could be used. Another application was in treating molybdenum ores. The entire molybdenum production of the country came from floating an ore running less than 1 per cent, a large per cent of the tonnage of which had to be dropped as barren pyrite. As for iron itself, although the constant tendency in flotation had been to drop it, it nevertheless was coming into its own in the production of pyrite for acid manufacture.

Oil-Shale Plant Running

M. J. Gavin, of the Bureau of Mines, telling of the initial results of the Government oil-shale testing plant, said that it had made its first production of oil on Sept. 18. The cost of construction had been kept so well within the estimate that it had been possible to install an American N. T. U. retort in addition to the retort of the Scottish type first provided. The problem of producing oil had been worked out, he said. That of mining the shale at a sufficiently low cost remained.

"The Ever New West"

George Otis Smith, Director of the U. S. Geological Survey, in an eloquent address on "The Ever New West," told how in his travels he saw the gradual and continual changes in the country as its development progressed. The days of the pathfinder were not passed, he said. The new West called for the opening of new trails. The frontier today was industrial, not geographic. Not all the sources of wealth had been discovered, nor all the land brought into the full possession of its occupants. Safeguarding the present and the future America was the purpose of the country's governmental activities. The practical policy now applied to the vast mineral estate still remaining in public ownership was designed to plan for its use without waste of the resources and for the intelligent distribution of that use as to time. Planning for the country's future was paternalism of the proper sort.

The primary purpose in handling this estate was not revenue but highest use, Dr. Smith said. As a landlord, the Federal Government was concerned with far more than the money it collected for itself and for the states. It was the interlocking of these interests, local and national, present and future, that was so obvious in the new program of development.

Extension of the leasing plan to metal mining, in Dr. Smith's personal opinion, was not warranted. But to the supplies of mineral fuels and water resources a much larger public interest attached. Upon their proper use depended the general prosperity of the future, and so the public wisely asked that over them the government should retain some degree of control, now seemingly effected by the present leasing laws, if properly administered. It had been to safeguard the interests of the actual discoverer and the bona fide developer against those who wished to acquire something without effort that recent land legislation had been passed.

Co-operation in Geological Surveys

W. C. Mendenhall, chief geologist of the U. S. Geological Survey, had for his topic "Co-operative Geologic Surveys in Colorado." Each year the search for new mines became more difficult, he said. So if it were to be successful it must be conducted with all the knowledge at man's command. As the old prospector faded from the scene, some one of equal hardihood and patience, armed with all that had been learned about the causes and conditions, the indications and hiding places of metals, must take his place. In the prospecting of the future, geologist, mining engineer, and operator must work together. They must pool their facts. From such co-operative work success was sure to come. Discoverable and as yet undiscovered values certainly existed in Colorado.

The metal-mining men of Colorado, continued Dr. Mendenhall, had proposed to secure for the state a larger share of Federal energy by tendering co-operation on a cost-sharing basis, a proposal that had been accepted. The general plan proposed was to supplement the available detailed studies that had been made of so many of the principal producing districts of the state by similar studies of less known and thus far less productive districts. Some of the older and better-known districts would probably be re-entered to study what later development had revealed. Earlier conclusions might thus be modified. The purpose of this work would be to detect, if possible, by geologic methods areas which offered favorable environment for ore deposits not now known. Too much could not be expected of it. But it was doubtless true that the areas that offered most promise were those in the immediate vicinity of the known deposits.

As part of the intensive study of special areas topical studies should be conducted, said Dr. Mendenhall, such as the relations of ore deposits to intrusive bodies, the effects of various types of host rocks upon mineralization, primary changes in the metal content of veins with variation in depth, effects on metal content of secondary enrichment, and interpretation of vein outcrops as indicators of metal content below. In Colorado, a study of the change in metal content with depth seemed worthy of especial attention. In concluding, Dr. Mendenhall said that in Colorado the time had passed for cursory reconnaissance examinations in the metalliferous belt.

G. F. Loughlin, of the U. S. Geological Survey, followed Dr. Mendenhall with a paper on "Ore at Deep Levels in the Cripple Creek District," which was received with considerable interest. Dr. Mendenhall had previously referred to this paper as an example of a supplemental study of an old district such as he had mentioned.

The Topographic Map

Colonel C. H. Birdseye, chief topographer of the Geological Survey, described the future program of the government as to topographic mapping in Colorado and the Rocky Mountain states. Of the Colorado area 52 per cent had been topographically mapped, but less than 40 per cent was accurate; 30 per cent of Wyoming had been mapped and adequately; likewise 22 per cent of Utah and 33 per cent of New Mexico. Of the last two maps much had been inadequately done. The maps were needed now. At the present rate of work they would be ready in fifty years. The program had dragged along for forty years. The Temple bill had for its purpose the completion of the topographic map of the United States in twenty years. Beginning with 1924, a progressive program had been under way with state co-operation. Some of the states were holding back, he said, apparently in the hope that if they waited long enough the Federal Government would bear the full expense. Two commissions, said Colonel Birdseye, had reported favorably on the joining of the public land survey and the topographic survey.

Charles W. Henderson, of the U. S. Geological Survey, and secretary of the Colorado Section of the A. I. M. E., and John Wellington Finch presided at the sessions of the Institute meeting.

Finding Ore

"Ore Finding" was the topic of Augustus Locke at the only evening session of the convention. Why this

association of geologic technique with ore finding? asked Mr. Locke. Because, he said, the cost of finding ore by the old method had mounted so high that one district after another had become practically dead and many others saw the end in sight. As an illustration he cited Leadville. As popular knowledge of its orebodies increased, a rather definite understanding grew up that what was called the "upper contact" was more favorable than any other place, but that the so-called "lower contact" was also good. These ideas were part of public opinion and were interpreted with more or less shrewdness, according to the individual. In the long run they fell back on mere luck. Then came Emmons. He determined the location of the ore in relation to the rocks and faults; he speculated on the origin of the ore. He gathered from far and wide in the hundreds of openings the information on the location of the faults and of the main and lower contacts, and then, with great skill, he prophesied where those faults and contacts were likely to be found in large unexplored regions of the district. This work increased extraordinarily the quality of the common knowledge in regard to finding ore. The common knowledge must be sound.

Foreign Competition in Copper

As another illustration, said Mr. Locke, the copper business of the United States was enjoying a flush production from the industrialization of large orebodies that had almost found themselves. In the last fifteen years little new ore had been found. The cream of easy discovery had been used up, he said. Yet while this flush production era seemed nearly over in the United States, another such flush era had got well under way in South America and still another was starting in Africa. So, as the industry here would have more and more difficulty in finding new ore, it would have to meet formidable competition of foreign copper produced at lowest discovery cost. The only prospect that we had of an outlet was in making improvements, and one of these would be to improve the methods of finding ore.

Principles of ore occurrence, however, would not be developed so long as the party of opinion prevailed that had no interest in principles and no belief that they could be worked out to practical conclusions. Today a tighter mining was required than in the fat days of the past. Exploration work was tightened up and confined to ground logically recommended by sharp and definite reasoning. What the geologist was supposed to do was to bring from all the world of science and industry all the new possible methods which became available. It was his special business to know everything that might find application.

The Petroleum Sessions

An ambitious program had been laid out for the American Association of Petroleum Geologists. It is even so at the meetings of the Petroleum Division of the Institute in New York. The great activity in the petroleum industry is doubtless responsible for this. Petroleum geologists are numerous and at the moment are doing many things and consequently have much to talk about. The pent-up pressure of a year of intensive field work finds vent at these periodic meetings, to the benefit of all concerned. Having in mind that those present in the mixed audiences at the sessions at this joint convention had one subject in common—geology—those who arranged the program in this instance restricted it to regional studies, and some interesting papers were presented. Among them were the following: "The Geology of Western Kansas," by Glenn C. Clark; "The Amarillo District," by J. V. Howell; "Geology of Southwestern Texas," by J. W. Beede; "Rocky Mountain Geology," by R. C. Coffin and T. S. Harrison; "Structure of the Coast Range and Its Relation to the Rocky Mountain Province," by Dr. Bailey Willis; "The Northern Cordilleran Geosyncline and Its Relation to Petroleum Accumulations," by C. A. Fisher and E. Russell Lloyd. The sessions were well attended and were marked by lively discussion.

Two trips were made by the petroleum men during the week—one to the Fort Collins oil fields and a longer one to the government oil-shale plant, at De Beque, Colo., which, as stated previously, has only recently begun production.

Mining and the Forest Reserve

On the last day of the convention the American Mining Congress took charge of what was practically the closing session, at the end of which the resolutions of the convention were presented for adoption. Mr. Callbreath presided. At this session the major topic was "Mining in the National Forests," which E. A. Sherman, associate chief forester of the U. S. Forest Service, discussed.

In creating the public reserve act of March 3, 1891, said Mr. Sherman, Congress provided that the forest reserve should continue under the mining law, subject to prospecting and patenting as though part of the public domain. This was the law today save for the disposition of certain lands by Congress. The mineral leasing act applied in the National Forests exactly as on the public domain; also the law as to precious metals. It was the policy of the Forest Service to encourage the development of mineral resources in the National Forests, said Mr. Sherman. The officers were instructed to aid and co-operate with industry and in most cases did so.

The laws as to the patenting of lode and placer claims, unchanged as to purchase price of lands bearing precious metals, still applied to both unreserved public domain and upon the National Forests. This was logical as to the public domain. The remaining lands were of low value. Conditions, however, had changed in the National Forests since the law was passed. There the land in large part had increased in value many times the original price. Only a small per cent of the land claimed or for which a mining patent was asked was actually wanted by miners for mineral purposes. Witness grabbing of valuable tracts for water-power, or a mineral claim plastered on every hot spring, or the location of public camp grounds by people who did not know enough about mining to stake a claim. When the Forest Service protested such claims as these, was it unbearable bureaucratic interference with gold digging? asked Mr. Sherman. It was unfair to charge such practices to miners or the mining industry. "The kind of activities that we would like to curtail are the kind that, I believe, you would wish curtailed," said Mr. Sherman.

New Regulations Proposed

What should be done about these abuses? asked Mr. Sherman. Legislative remedies had been proposed. One proposition would leave the law as it is with respect to mining values and uses but would remove the powerful incentives for misuse. But instead of leaving the surface fee in the Government and granting to the miner the right to use it so far as necessary for mineral development, it might be reversed and the fee granted to the miner with the reservation to the Government of the right to use it so far as necessary in reaching, protecting and developing adjoining government lands. Or the actual commercial value of the surface might be appraised and that value acquired in place of the $2.50 or $5 value, thus making an outright gift of the value of the orebodies as a reward for discovery and development work and preserving the principle of charging full value for other public property when it is taken for private use.

Criticism of Forest Service

Following Mr. Sherman, George E. Collins, of Denver, in a very comprehensive paper presented a Western view of the Forest Service. The law seemed to be fair, if loyally observed by both sides, he said. But power delegated to an official or bureau tended to increase and it was a duty to resist the unauthorized growth of official powers. "Forest" undoubtedly at the start meant wood, but much of the reserve today was land where timber would not grow. The unpopularity of the Forest administration, said Mr. Collins, was one reason for the lessening of prosperity in Colorado. A complete change of heart was needed in the Forest Service, he said. It was not so much the thing they did but the nasty way they did it. It was a bad day for mining when the National Forests were turned over to the Department of Agriculture. If it were necessary that examinations be made to protect the forest areas, the findings should be subject to review by some competent authority.

Scope of Work of the U. S. Bureau of Mines

Dr. Dorsey A. Lyon, chief metallurgist of the U. S. Bureau of Mines, talking on the work of the Experiment

Stations, said that Mr. Callbreath had been mainly instrumental in forming the Bureau and asked him what he thought the Bureau might best do for the mining industry. Mr. Callbreath replied that it could best serve by taking up those problems that the industry could not profitably work on for itself. Dr. Lyon, resuming, said that the Bureau had no police powers and regulations and did not want them. He briefly described its organization and told how the work to be done was divided among the stations. The Bureau, he said, tried to render service along all these lines. At the same time, it tried to avoid any work that consulting engineers could do.

The Small Operator's Technical Staff

Max W. Ball made a plea for more adequate support for the U. S. Geological Survey. This, he said, he made solely as one who for several years had been a small operator engaged in oil exploration and production. The small operator was indispensable, said Mr. Ball. He supplied to the field of exploration an open-mindedness and a gambling instinct that the larger companies did not wholly share.

It was to the Survey that the small operator turned for technical aid and guidance, said Mr. Ball. Unable to maintain the expensive staff of the large operator or to spend great sums on exploration and research, he had but one source of help when needed—the technical bureaus of the government: the U. S. Geological Survey and Bureau of Mines. The Survey's regional investigations were of outstanding value to the oil operator, large and small. Free from the necessity of locating geologic structures for immediate drilling, it could devote its limited resources to a study of broader problems—broader some of them than even the largest companies cared to undertake. These regional investigations made possible intelligent exploratory work by the small operator and helped to bring him within competitive distance of the larger companies with their elaborate geological organizations.

For his broader detailed geologic studies the small operator was dependent almost wholly on the Federal Survey. It was, moreover, the Survey to whom he sent his sample for analysis when his well started making water; the Survey that aided him if he had a gas well out of control, or that advised him were he in doubt where to set his pipe. All this, said Mr. Ball, resulted in proper operation by large and small organizations, preventing irreplaceable losses of oil.

Survey Not Given Adequate Support

With this great possibility of usefulness the Survey should be reasonably supported, so that it might be able to render these helps and aids to the greatest extent desired, the speaker said. But all knew that it was not. Instead, by reason of inadequate appropriation it hardly managed to maintain its useful work. In 1916 its appropriation was $350,000. In 1926 it actually received $25,000 less. Here was an organization which constituted the small operator's technical staff and helped maintain him in competition with his rivals, and which attempted to cover the whole United States, and yet it received an appropriation less than a single large oil company should spend for the same purpose.

A paper on "Mine Safety," by E. H. Denny, district engineer of the Bureau of Mines, concluded the closing session of the convention.

Resolutions

At this closing session, after Jesse McDonald, governor of the Colorado Chapter of the Mining Congress, had taken Mr. Callbreath's place as chairman, the resolutions, mentioned as follows in abstract, were presented to the convention by A. G. Mackenzie, of Salt Lake City, and adopted:

Indian Silver — Recommending that Washington study the situation in India as described by Mr. Brownell in his speech and that the Federal Government take such action as it may properly take to prevent the adoption of the Royal Commission's report, at least so far as the sale of 700,000,000 oz. of silver or any part of it is concerned, and to maintain, so far as possible, the present use of silver by the people and the Government of India.

Pittman Silver Repurchase Bill—Urging its speedy passage at the next Congress and urging interested bodies to press their representatives in Washington to this end.

Research at Government Oil Shale Plant—Urging that Congress appropriate sufficient funds to permit the research work to be continued at the expiration of the year that is now provided for.

Mining on the National Forest—The text of this resolution, as adopted, is as follows:

Resolved, that the mineral lands contained in the National Forests should remain open for location, appropriation and use, under the existing laws; and that the Forest Service should endeavor by all means in its power to facilitate and encourage such location, appropriation and use, subject only to such general restrictions as may be necessary to protect the woodlands and watershed from damage and destruction.

That in case of objection being raised, on behalf of the Forest Service, to any mineral appropriation or claim on the public domain, during pendency of proceedings for patent or otherwise, the Department of the Interior should proceed to ascertain through a referee or referees of unquestioned ability and experience, who shall demand the confidence and respect of miners and prospectors both as to their knowledge of mines and their integrity, and without expense to the claimants, the facts concerning the appropriations or claims in question, so that the rights of the locators thereof shall not be prejudiced by objection raised on behalf of the Forest Service.

That rights of way for water, power, transport of ore and other purposes necessary to the development or operation of mines should be freely granted, subject only to such charges or to such conditions as shall be necessary to compensate for damage done or to be done to said forest, or to provide for safeguarding of the woodlands thereon.

School Lands—The text of this resolution in full is as follows:

Whereas, the Western land grant states of Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, North Dakota, South Dakota, Oregon, Utah, Washington and Wyoming have been granted certain lands by the government for the benefit of the common schools and institutions of higher education; and

Whereas, by the terms of a number of these grants and by judicial construction and departmental rulings as to the balance, the mineral rights in the lands granted have been retained by the government; and

Whereas, the surface rights of much of the lands of these grants are of little or no value and contribute only in small part to the cost of education in the various states; and

Whereas, the principal object to be attained by these grants will be defeated unless the mineral rights are relinquished to the states;

Therefore, be it resolved, by the Western Division of the American Mining Congress, that the United States should relinquish to any state or territory all right, title and interest of the United States to the lands, irrespective of their character, granted to such state or territory, for the support of or in the aid of common or public schools, as provided for in Senate Bill 564 of the first session of the 69th Congress of the United States, passed by the Senate April 29, 1926, subject to the provisions of such bill.

Hydraulic Mining in California—Voicing the desire of the American Mining Congress to assist the citizens of California to the end that hydraulic mining may be resumed under the Débris Commission Act.

Stock Raising Homestead Act—Endorsing the suggestion of the Secretary of the Interior that it be repealed, and if it is not repealed but amended, recommending that it be so amended that all areas known to be mineral in character, but otherwise subject to entry under said act, be permanently withdrawn from entry thereunder, and that on all other lands entered and patented under said act the mineral rights shall pass to the patentee in fee.

Public Lands—Favoring united action of all public land states on all questions particularly affecting the common welfare of such states and offering to them the aid of the organization and facilities of the American Mining Congress for perfecting the necessary machinery.

League of Rocky Mountain States—Endorsing the suggestion for a League of Rocky Mountain States for securing united action on all questions, particularly affecting the common welfare of these states.

Men You Should Know About

Arthur L. Flagg, of Phoenix, Ariz., was in New York last week.

Albert S. Konselman, mining engineer, of Los Angeles, Calif., is in New York.

J. V. N. Dorr, president of the Dorr Company, has returned from a short trip to Europe.

George H. Garrey stopped at Salt Lake City while en route to examine mines in Idaho.

Dr. Kuno B. Heberlein has returned to Europe after a six months' stay in the United States and Mexico.

O. B. Hundley, assistant reduction superintendent of Chile Copper Co., is visiting in Butte and Anaconda.

President Jules Bache, of the Dome Mines, Ltd., of South Porcupine, Ont., has returned from a visit to Europe.

A. W. Allen is in the Neuquen district of the Argentine, on professional work. He expects to return to Chile in the near future.

F. F. Sharpless, formerly for many years secretary of the A.I.M.E., left New York on Sept. 26 for Idaho, where he will be engaged in professional work for two weeks.

F. E. Calkins, mining engineer, of Globe, Ariz., has returned from the examination of mines in southern Mexico and is now examining properties in Arizona and California.

W. C. Mansfield, of the Geologic Branch of the U. S. Geological Survey, has been at Langley's Bluff, Md., engaged in a study of the Tertiary paleontology of that region.

Alan M. Bateman, professor of economic geology at Yale University, has just returned from Europe, having left here in April to attend the International Geologic Congress at Madrid.

H. A. Eye, assistant manager of the Mexican smelting department of the American Smelting & Refining Co., with headquarters at Mexico City, was recently on a brief visit to San Francisco.

Dr. A. L. Hall, assistant director of the South African Geological Survey, has returned to Pretoria and resumed his official duties, after attending the International Geological Conference at Lisbon.

T. F. Cole, of New Greenwich, Conn., and **R. M. Atwater, Jr.,** of New York, president and vice-president, respectively, of the Seneca Copper Co., were recent visitors at the property in Keweenaw County, Mich.

H. Norton Johnson, secretary of the San Francisco section of the A.I.M.E., has resigned the secretaryship as a result of being transferred to southern California. He will make his headquarters at Los Angeles.

John Walbloom, formerly foreman of International Smelting Co.'s operations at Eureka, Utah, has been made superintendent of the Walker Mining Co., Spring Garden, Plumas County, Calif., control of which is owned by the International Smelting Co.

A. H. Hubbell, managing editor of *Engineering and Mining Journal,* after attending the Denver meeting of the Western mining men, is visiting the mining districts in Colorado, New Mexico, and Texas. Mr. Hubbell's report of the Denver convention will be found on pages 546 to 553 of this issue.

Louis E. Reber, Jr., recently arrived in Northern Rhodesia with two assistants, **A. H. Down** and **H. G. Hymer,** to spend a year on geological work for Rhodesian Congo Border Concessions, Ltd., having left his position as chief geologist for United Verde Copper Co., at Jerome, Ariz.

Sydney H. Ball

Sydney H. Ball and **Allen H. Rogers,** of Rogers, Mayer & Ball, have returned to New York, after having spent two months in Peru.

Samuel A. Taylor, president of the A.I.M.E., accompanied by **H. Foster Bain,** secretary, is visiting various large camps in Arizona. Bisbee and Douglas held meetings in his honor on Sept. 13 and 14, respectively; Tucson on the 15th, Globe on the 17th, and Jerome a few days later.

F. A. Goodale, of the Columbia Shale Oil Co., of Colorado, accompanied by Messrs. **Conacher** and **Brown,** of Scottish Oils, Ltd., is in New York inspecting the plant of the American Hydrocarbon Co., Inc., preparatory to adopting the lead-jacketed low-temperature process for the treatment of shale.

Guy C. Riddell has returned to New York from four months on the Pacific Coast. Accompanied by **E. D. Foster,** mining geologist of Los Angeles, and other engineers on the coast, he examined the principal oil shale deposits in California. He is making a similar survey of the oil shale situation in the Indiana-Kentucky-Tennessee region.

J. H. Horsburgh, assistant general manager of the Mount Morgan Co., Queensland, Australia, has been appointed by the Australian Federal Government as chairman of a commission of three to undertake the development of North Australia. The duties of the commission of which Mr. Horsburgh is now chairman relate to the development and control of that part of the Northern Territory of Australia north of the 20th parallel of south latitude.

Arthur B. Parsons, assistant editor of *Engineering and Mining Journal,* has returned to New York from a field trip in Canada. He visited the Eustis copper mine, in Quebec; the Porcupine and Kirkland gold areas, in Ontario; the Cobalt and South Lorrain silver districts; and the new copper-gold region lying between Rouyn, Quebec, and the Ontario border. An account of activities at the remarkable Horne mine and the various mines and properties lying west and north of Rouyn will be published in an early issue of *Mining Journal.*

C. Q. Swanson and **R. H. B. Jones,** of the University of Wisconsin; **N. A. Stearn,** a mining engineer, of St. Louis; and **Adam Lunoe,** a journalist, of Miami, Florida, recently returned from a geological reconnaissance in the Peace River district of British Columbia. The expedition, which left Hazelton toward the end of last June, was financed by a syndicate of Michigan capitalists. Beyond the fact that they had traveled over a considerable area of previously unexplored territory and found a good deal of coal, the members of the expedition gave out no information as to the result of the trip.

B. D. Stewart, supervising mining engineer for the U. S. Geological Survey in Alaska, recently returned to Juneau from Washington D. C., where he has been conferring with officials of the Survey relative to co-operative work between the Territory and the Survey. Mr. Stewart reports that he will carry forward the work now in progress, that of collecting authentic information as to the nature, extent, and availability of the known mineral resources of the Territory. This work has been in progress for two years with **N. L. Wimmler** as placer mining engineer and **H. H. Townsend** and **Gowey Shephard** as district mining engineers, paying particular attention to lode mining. Mr. Wimmler is continuing his investigation of placer mining and costs, particularly along the Alaska Railway belt and through interior Alaska. He is now in the Fairbanks district, where he will be joined by **Frank H. Holzheimer.** They will proceed down the Yukon River. Mr. Holzheimer will make a special study of the Iditarod and Kuskokwim districts and Mr. Wimmler will proceed to Nome. Mr. Townsend will soon resume lode-mining investigation in the Alaska Railway belt and Mr. Shephard is now at work in his district, which embraces Southeastern Alaska.

Obituary

Stalker E. Reed, born April 6, 1890, died Aug. 31, 1926, of meningitis. He was graduated from Massachusetts Institute of Technology in 1912. Among the positions held by him were: Engineer for Oliver Iron Mining Co., Hibbing, Minn.; engineer and superintendent of the Providencia and Ojuela mines, Cia. de Minera Peñoles, S. A., Mapimi, Mexico, and at the time of his death he was superintendent of the Parral unit of the American Smelting & Refining Co. Mr. Reed was well known in northern Mexico. He leaves a widow and three children.

New Machinery and Inventions

Small Mills for Base Metal Ores

25- and 50-Ton All-Flotation Units in Standard Layouts Completely Assembled Before Shipping Are Now Available

By E. R. Cullity*

Until recently small-scale milling operations, having for their objective the treatment of copper, lead and zinc ores, have been unprofitable. It was exceptional to find a 100-ton or smaller plant that remained in successful operation for a period of even one year.

Several conditions militated against the operator who sought, on a small scale, to concentrate his ores before shipment. Disregarding the mining factor and restricting this discussion to milling alone, failure of small concentrating mills has been generally due either to faulty mechanical design, assembly and erection, or else to improper metallurgical design. In other words, the small mill was destined to failure for the reasons that it rarely operated continuously and smoothly and, if it did run, the probabilities were that the metallurgical treatment involved was not suited to the ore.

The small operator is up against the necessity for strict economy in the construction of his mill. Usually he is unable, or unwilling, to make the necessary expenditure for the technical service of ore testing, mill design and erection. As a rule, the procedure was to accumulate and set up at the least expense the cheapest equipment deemed suitable for the purpose. Used and salvaged machinery or innovations in metallurgical equipment of low first cost and unproven merit were frequently installed, erected and made to run. The mill operation ordinarily was subject to 25 to 60 per cent lost time for interruptions due to various mechanical defects and the consequent delays diminished the possible profit to the vanishing point.

There are undoubtedly many small mines with orebodies upon which a 25 to 50-ton mill would make a profit and on which a larger plant would not be justified. The problem has been to get a mill of this size which will at least approach the larger installations in smooth running, efficiency and metallurgical results.

Flotation has resulted in a greatly simplified flow sheet and has materially helped to solve the problem of the small milling plant. Stage grinding, screening and elaborate classification are largely eliminated. Whereas it was once almost impossible to duplicate economically in a small mill the design and operation shown to be successful in larger plants, it is now possible to duplicate a flotation layout on a comparatively small scale.

The final solution of the small mill problem has been obtained by adopting the simplicity of the all-flotation flow sheet in a standard layout completely assembled before shipment by skilled mechanicians after designs by technicians. Such small plants are now available and at least one manufacturing concern has shown sufficient initiative to solve this important problem. A 25-ton and a 50-ton unit designed to accord with the experience obtained in larger units has been placed upon the market. Standard equipment and a flexible arrangement that will permit of necessary modifications to meet special conditions are included in the designs of these small units. Crusher, feed hopper, ore feeder, ball mill, rake classifier, flotation machine, reagent feeders and mechanical accessories are all of types that have proved their efficiency in service. A structural steel frame, well designed, makes the unit self-contained and restricts the preliminary construction to foundation work. The arrangement is as nearly foolproof as possible. The unit is dissected into parts admitting of convenient transportation, which is a necessary requirement.

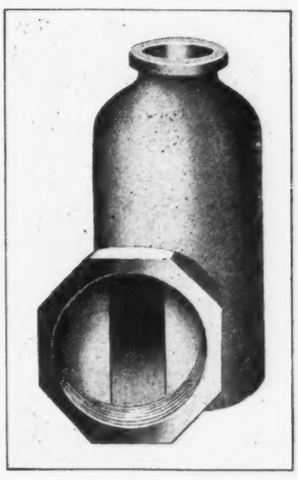
It is my opinion that small mills of the type indicated will fill a long-felt need in the mining industry for they will serve to give an outlet to lower grade ores. They can also be used for pilot mill purposes on a developing property. Their portability makes them of service in working old dumps. Once they have served their specific purpose, they have a resale value that is a considerable portion of their original cost.

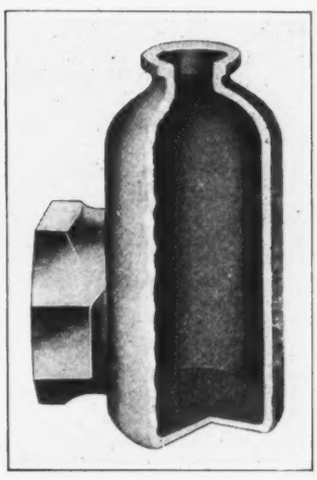
*Sales Engineer, Southwestern Engineering Corporation, Los Angeles, Calif.

Nozzle Throws Whirling Spray

For years the Power Plant Equipment Co., of Kansas City, Mo., has manufactured special castings and fittings for spray-pond equipment. Recently it has developed the Marley spray nozzle shown in the accompanying illustration. The unusual features of this design include a large rectangular Venturi-shaped inlet and a bottle-like whirl chamber. The free cross-sectional area is large throughout. The water enters from the side through a converging throat which tends to minimize eddy and pressure losses. The incoming water is admitted at maximum velocity imparting a strong whirling motion which is accentuated by the whirl chamber. The discharge is through a comparatively large orifice at the top.

With large free openings throughout and no projections or deflectors, clogging of this nozzle is practically eliminated. It is claimed that it will pass freely any solid matter that can work its way through a surface condenser. It is manufactured for all standard pipe sizes and for a wide range of pressures.





Sections of whirl chamber

Water enters this spray nozzle through an eccentric, rectangular, Venturi-shaped orifice. A strong whirling motion is thus imparted to the contents of the chamber which causes the water to leave the escape nozzle in a fine spray highly effective for cooling purposes.

New Pot for Melting Metals

A new metal-melting pot, with a capacity of approximately 1,000 lb., has been added to the General Electric line. This pot, utilizing the electric heating principle, is practically the same as other standard G-E melting pots except that three cast-in, sheath wire immersion heating units are used.

Each heating unit is rated 5 kw. The pot may be operated either on 110- or 220-volt a.c. or d.c. circuits and the use of three heating units will also permit balanced 3-phase operation.

The pot itself consists of a sheet steel cylindrical casing in which is supported a cast-iron crucible of the following dimensions: Inside, 18 in. in diameter and 15 in. in depth; outside, 29 in. in diameter and 31 in. in depth. The space between the casing of the crucible, measuring about 3 in., is efficiently insulated with a compact heat insulator. The leads of the heating units are brought over the top of the pot into a connection box fixed to the unit itself.

Melting pots of this type are designed for melting lead, babbitt, tin, solder and similar alloys or metals, except spelter or zinc, at temperatures not exceeding 850 deg.

Full-automatic control is recommended, consisting of a standard automatic control panel and a temperature control instrument equipped with a special bulb for metal immersion.

Separate heating units may be installed in existing installations of melting pots where dimensions permit and temperatures do not exceed 850 deg. F.

The Market Report

Dull Week in Metal Markets

Lead Prices Slightly Easier—New York Silver Drops to 57⅜c.

New York, Sept. 29, 1926—Unusual dullness characterized the non-ferrous metal markets for the week ending today. Except for silver, which reached a new low of 57⅜c. per oz. in New York, there was little change in prices, though tin is somewhat stronger, and lead is a trifle weaker. Antimony and platinum are off, and quicksilver prices are firmer.

Light Trading in Copper

Following two fairly good weeks, the past one has been comparatively dull for copper sellers, in both the domestic and foreign markets. There is no doubt that consumers have very small stocks of raw material, but they show little interest in the metal at any price. In the Connecticut Valley 14.25c. delivered has been the prevailing price, though one or two sales have been made at 14.20c. since Monday. In the Middle West prices have ranged from 14.33c. to 14.45c., with the largest single sale being made on Wednesday at 14.35c. Deliveries are principally for October, with some for November and very little as far ahead as December. Producers have done some foreign business at 14.40c. and 14.45c., but traders have offerings as low as 14.325c. c.i.f.; 14.05c. and 14.10c. f.a.s. have been done on small lots. At least two producers are out of the market at current levels.

Zinc Steady

Less than the normal amount of zinc has changed hands during the week, at prices ranging from 7.35c. to 7.40c. per lb. for Prime Western, and from 7.40c. to 7.45c. for Brass Special. The demand for the better grade metal seems light and the premium is only about 5 points. On the other hand, the demand for High-Grade is brisk, and one producer finds his position so good that he has marked the price up to 9½c. per lb., New York. Others have maintained the 9c. level that has prevailed recently. It is generally agreed that the business of brass makers is excellent, but, as in the case of copper, they are disinclined to buy zinc at the moment.

Lead Slightly Weaker

Though no change has been made in the contract price for lead set by the American Smelting & Refining Co., which continues at 8.75c., New York, the lead market is somewhat weaker, following the slight decline in London prices. Consumers have not bought so actively as last week. Almost every order has been for small tonnages for prompt or early October shipment, and as consumption continues at an excellent rate, sellers would probably be swamped with orders should the market take a turn for the better. Most of the inspiration seems to come from London, however, and there seems little immediate hope for an advance in that market.

Some sellers would be willing to release lead at concessions from the Smelting company's price in the East, though that tendency is not general, and but little lead has been sold for less than 8⅜c. In the Middle West, the leading producers have come down to 8.40@8.425c., dealers having offered as low as 8.40c. throughout the week.

Tin Again Up

Prompt Straits tin dipped a little below the 70c. mark during the week, but in the last three days has again sold at close to record prices for this movement. Consumers have not been active and are buying, in general, only for immediate requirements. October

Daily Prices of Metals

Sept.	Copper N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
23	14 05	67 00	69 50	8 725	8 45	7 35@7 40
24	14.025	67 00	69 375	8 725	8 40@8 45	7 35@7 375
25	14.025	67 00	69 375	8.725	8 40@8 45	7 35@7 375
27	14 00	67 50	70 375	8.725	8 40@8 45	7 375
28	14.025	68 00	71 00	8 725	8 425	7 35@7 40
29	14 025	67 50	70 25	8 725	8 40@8 425	7 375
Av.	14 025	67 333	69 979	8 725	8 427	7 371

The prices correspond to the following quotations for copper delivered: Sept. 23rd, 14.30c.; 24th and 25th, 14.275c.; 27th, 14.25c.; 28th and 29th, 14.275c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Sept.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
23	58½	59⅛	66	307½	299¼	31⅞	31¾	34⅜	34¼
24	58⅛	58⅞	66	306¾	299½	31¾	31 9/16	34 7/16	34¼
27	58⅛	59	66⅛	311	301½	31¾	31 9/16	34⅝	34 7/16
28	58⅜	59⅛	66¼	313½	302¾	31¾	31 9/16	34¾	34 9/16
29	58⅜	59⅛	66¼	312½	301¾	31 11/16	31½	34¾	34½

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Sept.	Sterling Exchange "Checks"	Silver		Gold London	Sept.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
23	4 84⅞	60	27 11/16	84s11½d	27	4 84⅝	58⅛	27	84s11½d
24	4 84¾	59⅜	27¼	84s11½d	28	4 84⅝	58¼	27	84s11½d
25	4 84⅝	59¼	27¼		29	4 84⅝	57¾	26 7/16	84s11½d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

promises to be another tight month. Forward deliveries have sold at concessions of about 1c. per month from the prices asked for prompt.

Silver Drops to New Low

China has continued to sell heavily throughout the past week, causing almost daily breaks in the price of silver. About midway in this recent decline, the bazaars came in as buyers, but continued selling pressure from China and the reported failure of the Russo-Asiatic Bank caused a reversal of India's position, and a consequent further drop on Sept. 29 to new low quotations for the year of 26 7/16d. in London and 57⅜c. in New York. These rates have not been reached in London since Dec. 31, 1915, when the price was 26¼d., nor in New York since June 9, 1921, when the quotation was 57⅜c.

Mexican Dollars (Old Mexican pesos): Sept. 23d, 45⅝c.; 24th, 45c.; 25th, 45⅛c.; 27th, 44¼c.; 28th, 44⅝c.; 29th, 43⅝c.

Lire and Francs Firm

The foreign exchange market has been quiet, with francs and lire firm the last two or three days. Closing cable quotations on Tuesday, Sept. 28, were as follows: francs, 2.81c.; lire, 3.8125c.; and marks, 23.82c. Canadian dollars, 5/32 per cent premium.

Other Metals

Quotations cover large wholesale lots unless otherwise specified. London prices are according to latest mail advices.

Aluminum—Both 98 and 99 per cent grades quoted at 27c. per lb. London, £118 per long ton for domestic metal.

Antimony—Per lb., duty paid, New York; Chinese brands, spot, 14½@14c.; November 13⅝c.; December 13½c. Cookson's "C" grade, 17⅜@18c. Needle and oxide nominally unchanged from quotations in the Sept. 4 issue.

Bismuth—Per lb., New York, in ton lots, $2.70@$2.75. London, 10s.

Cadmium—Per lb., New York, 60c. London, 1s. 10½d. for American metal; 1s. 9d. for Australian metal.

Iridium—Per oz., $130@$140 for 98@99 per cent. Firm. London, £63@£65 in iridio-platinum.

Nickel—Per lb., ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent grade). London, £170@£175 per long ton according to quantity.

Osmium—Per oz., $55@$65. London, £17@£20.

Palladium—Per oz., $66@$70. Pure metal as a constituent of crude platinum, $50@$55 per oz. London £12@£15, nominal.

Platinum—Official price on refined metal, $115 per oz. This represents a cut of $3 on Sept. 23, to bring the nominal official price more in line with the actual market. Open market cash sales of large lots, $110. Pure metal as a constituent of crude platinum, $107.

London, £23½ per oz. for refined and £21@£21½ for crude.

Quicksilver — Per 75-lb. flask, $92.75 @$94. San Francisco wires $91.67 steady. London, £16½.

Ruthenium—Per oz., nominally $50@$60.

The prices of **Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Radium, Rhodium, Selenium, Tantalum, Tellurium, Thallium, Tungsten,** and **Zirconium** are unchanged from the issue of Sept. 4.

Metallic Ores

Tungsten Ore—Per unit of WO_3, N. Y.: Wolframite, $10.50@$10.75; Western scheelite, $11@$11.25.

Chrome, Iron, Manganese, Molybdenum, Tantalum, Uranium, and **Vanadium Ores** are unchanged from quotations in the Sept. 4 issue.

Zinc Blende Lower—Lead Ore Steady

Joplin, Mo., Sept. 25, 1926

Blende	Tons
High	$54.25
Premium, basis 60 per cent zinc	$50.00@51.00
Prime Western, 60 per cent zinc	49.00
Fines and slimes, 60 per cent zinc	48.00@45.00
Average settling price, all blende	49.24
Galena	
High	$115.00
Basis 80 per cent lead	110.00
Average settling price, all lead	112.05

Shipments for the week: Blende, 15,517; calamine, 130; lead, 2,642 tons. Value, all ores the week, $1,064,600.

Shipments for nine months: Blende, 625,001; calamine, 727; lead, 93,956 tons. Value, all ores nine months, $40,985,520.

As a result of the lower price offering for blende, buyers could procure only 11,730 tons this week, owners of the heavier producing mines declining to accept the price cut. Production continues around 17,000 tons. September shipments exceeded the output by 3,080 tons, and during the nine months production has exceeded the shipment by 7,520 tons.

Lead prices were on a basis of $110 throughout the week, all buyers reporting the same price level.

Heavy rains during the month prevented an increase in production, although additional mills are in operation. A few small producing mines were flooded over the top, and the seepage of surface water is increasing drainage expense.

Platteville, Wis., Sept. 25, 1926

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$52.75
Lead Ore	
Lead, basis 80 per cent lead	$112.50

Shipments for the week: Blende, 1,055 tons; lead, 40 tons. Shipments for the year: Blende, 40,632; lead, 1,486 tons. Shipments for the week to separating plants, 2,411 tons blende.

Non-Metallic Minerals

Fluorspar—In *New Mexico;* 85-5 gravel, $16 per ton; lump, $16.50; ground, 100 mesh, $35. Market good. Other fluorspar prices unchanged from Sept. 4 issue.

Magnesite—Per short ton, f.o.b. California mines, grade "A" calcined, 80 per cent through 200 mesh, white, for plastic purposes, $45 per ton. Market fair.

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Ilmenite, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystals, Silica, Spodumene, Sulphur, Talc, Tripoli, and **Zircon** are unchanged from prices in the Sept. 4 issue.

Mineral Products

Arsenious Oxide (White Arsenic)—3½c. per lb. Demand continues fair but prices show no change. London, £13@£13½ per long ton for 99 per cent.

Calcium Molybdate, Copper Sulphate, Sodium Nitrate, Sodium Sulphate (Salt Cake), and **Zinc Oxide** are unchanged from prices in the Sept. 4 issue.

Ferro-Alloys

Ferromanganese — Domestic, 78@82 per cent, $88@$95 per long ton, furnace, prompt and future. Spiegeleisen unchanged from Sept. 4 issue.

Ferrocerium, Ferrochrome, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and **Ferrovanadium** are unchanged from prices in the Sept. 4 issue.

Metal Products

Rolled Copper—Per lb., sheets, 23c.; wire, base price, 16½c.

Lead Sheets, Nickel Silver, Yellow Metal, and **Zinc Sheets,** are unchanged from the prices in the Sept. 4 issue.

Refractories

Chrome Brick—$50 per ton, f.o.b. shipping point.

Magnesite Brick—$65@$70 per ton for 9-in. straights, f.o.b. works.

Silica Brick—$43 per M, *Pennsylvania* and *Ohio;* $52@$55, *Alabama* and *Illinois.*

Fireclay Brick and **Zirkite** are unchanged from quotations in the Sept. 4 issue.

Steel, Pig Iron, and Coke Strong

Pittsburgh, Sept. 28, 1926

September witnessed approximately the same volume of bookings and shipments in steel as August, when there was a 10 per cent increase in steel production over July, the low month of the year, yet a month of heavy production by longer-range comparisons.

Production and shipments of steel in the nine months of the year run about 11 per cent above those in the same period of last year. The more common expectation is that tonnage will average somewhat lighter in the last three months of the year, slightly cutting down the lead of this year over last.

Pig Iron—Sales of fully 1,500 tons of bessemer iron have been made at $19, and the $18 price done a few weeks ago is out of the reckoning, while the $17.50 price on foundry iron is expected to disappear any time. Bessemer, $18.50@$19; basic, $17.50; foundry, $17.50@$18, f.o.b. Valley furnaces.

Connellsville Coke—The spot furnace coke market is up fully 15c., being now at $3.40@$3.60, and spot foundry coke is expected to advance in sympathy from its long held level of $4@$4.50.

Company Reports

Benguet Consolidated Mining Co.

Gold-Silver; Philippine Islands

The report of the Benguet Consolidated Mining Co. for the six months ending June 30, 1926 states that 45,400 tons of ore were treated, of an average value of 36.74 pesos per ton (1 peso = 50c., U. S.), and gold and silver of a gross value of 1,544,034 pesos was produced. Other receipts increased the total to 1,570,623 pesos. Operating expenditures amounted to 598,385 pesos, to which was added 93,294 pesos for depreciation, 46,114 pesos for development, and 20,821 pesos as a bonus for the general manager, leaving a net profit of 812,009 pesos. No dividends have been paid since the last report, nor are any contemplated in the near future, though a capital distribution of 20 centavos per share was paid on March 31. There are outstanding, 2,000,000 shares of a par value of 10 centavos each.

Diamond drilling has disclosed additional ore the probable value of which is said to be most uncertain, but probable ore reserves have been extended somewhat. On June 30, 1926 the positive ore, exposed on four sides, amounted to 26,900 tons, valued at 926,064 pesos; and the probable ore, exposed on at least one side, amounted to 24,700 tons, valued at 691,600 pesos.

A. W. Beam is president and general manager, the report being signed by James S. Colbath, assistant general manager. The head office is at Manila.

Chile Copper Netted $6,160,000 During First Six Months

Net profits for the first six months of the current year were $6,160,857 according to the report of the Chile Copper Co. and Chile Exploration Co. just issued. This is after deducting miscellaneous expense, depreciation, federal taxes and interest. It compares with $5,602,647 in first half of 1925.

Net profit for the June quarter was $3,023,413 after all charges, comparing with $3,137,444 in preceding quarter.

The consolidated income account for six months ended June 30, 1926, compares as follows:

	1926	1925	1924
Total sales, pounds	108,083,227	94,260,618	103,984,796
Gross receipts	$15,422,316	$13,658,068	$14,050,779
Net profit*	6,160,857	5,602,647	5,395,588

*After deducting all expenses and charges, including depreciation, amoritized discount on 6 per cent convertible bonds, accrued federal taxes and accrued bond interest.

The company in first half of 1926 treated 3,826,173 tons of ore averaging 1.527 per cent copper and produced 108,886,692 lb. of copper, a monthly average of 18,147,783 lb. Output was 803,471 lb. in excess of sales as sales for the period came to 108,083,227 lb. in the six months.

Chile Copper Co. and its operating subsidiary Chile Exploration Co. had on July 31, 1926, $5,772,900 in cash and marketable securities compared with $5,837,400 May 31, 1926. Reduction is due to capital expenditures in connection with plant extensions under way.

Forecasts Results of Adoption of Indian Currency Commission's Program

Possible consequences of adoption of the proposals of the Indian Currency Commission for ultimately placing India on a gold-bullion basis are discussed by George E. Eddins of the National Bank of Commerce in the October issue of *Commerce Monthly*. The reform measures have been recommended by the commission, but have not as yet been adopted by the Indian government.

Mr. Eddins points out that the principal proposals of the commission, so far as they affect the silver market, contemplate the closing of the mints to further silver coinage for some time and the gradual reduction by the government of its very substantial silver reserve. Beyond these more immediate influences, it is the commission's hope that the establishment in India of a gold-based currency and the gradual growth of popular confidence in it may eventually turn the flow of Indian savings from unproductive hoards of the precious metals into more useful channels.

Annual world production of silver is about 240,000,000 oz., of which India in the last few years has been absorbing over one-third. If the currency commission's report becomes effective it will mean that the Indian Government, for some time at least, will not be a buyer of silver in the international market. The gradual establishment of the new currency will, it is expected, make possible a reduction of the government's silver reserve over a ten-year period from about 850,000,000 to about 250,000,000 rupees; that is, a disposition of about 206,000,000 oz. of silver.

Hoarded Silver May Be Offered for Redemption in Gold

The proposals of the Indian Currency Commission have avowedly been framed with a view to disturbing the silver market and the value of India's enormous stored-up wealth of silver as little as possible, says Mr. Eddins. The sales from the government's silver reserves in any given year are hardly likely to amount to so much as India's recent silver imports have totaled. On the other hand, there is the possibility which the commission envisaged in its report, that considerable amounts of silver rupees may come out of hoards to be redeemed in gold. In the commission's judgment, the outside amount of rupees that could conceivably come on the market from this source might aggregate something over a half billion ounces, though this is by no means the total of India's hoarded silver. It is impossible to foresee what part, if any, of this will actually come on the market. India may still be something of a buyer, and at times even a large buyer in the international market.

While the commission's report does not threaten any drastic unloading of India's silver, the announcement of its findings precipitated a decline in price on the London market to 28⅛d. per ounce, on Sept. 15. The average price in 1925 was 32d. In the New York market the price declined to 61⅜c. per ounce, the lowest quotation since 1921. (Since this was written the price in New York has declined to 57⅜c.—EDITOR.)

Though there are innumerable factors that affect the silver market either directly or indirectly, the most important influences are movements to India and China, the volume of world production, the requirements of the United States in the arts and industries and for coinage, and demand from European countries for similar purposes.

The hoarding of silver in India, as well as its use there in ornaments and heretofore for coinage, and the great requirements of the monetary system of China have constituted the chief outlets for the world production. Centuries of hoarding in India have accumulated a reserve, including treasure stores, estimated to be as high as a billion ounces, or about one-third of the aggregate production of the world's mines.

Heavy absorption in China is due primarily to the use of silver as the standard of value. In the absence of western systems of credit and paper currency, large quantities of metal are necessary to meet the needs of the vast population even with a very small per-capita circulation. The reform of Indian currency, if it is successfully accomplished, will leave China as the sole great country of the Far East with a silver standard. If silver prices should be subjected to extreme fluctuations in terms of gold, it is not impossible that China, too, in time will pass again to the gold basis prevalent in that country more than three thousand years ago.

Substantial fluctuations up and down are to be anticipated, thinks Mr. Eddins, but in the long run the tendency of silver prices seems more likely to be downward than upward. India is apt to be less of a buyer and possibly will be a seller of silver in the international market. China will be left the great free silver mart of the Far East, buying or selling according to the dictates of its keen-minded speculators and bankers. Europe will be less of a buyer than formerly for subsidiary coinage purposes. World production now at record high levels is not likely to recede in proportion to decreased demands for monetary purposes. However, the situation need not occasion undue discouragement. Since the middle of the last century silver has had to endure the shock of demonetization in one country after another. None the less its consumption has steadily increased.

Freight Rates on Metals, Ores, and Concentrates

Carload Lots

Copper Bullion and Refined Copper

From	To	Rate per Ton of 2,000 Lb. All Rail	Via Gulf
El Paso, Tex.	Baltimore, Md.	$11.40	$10.00
Garfield, Utah	Perth Amboy	12.50	.....[1]
Garfield, Utah	San Francisco	5.85	.....
Hayden, Ariz.	Perth Amboy	14.50	12.50
Miami, Ariz.	Perth Amboy	14.50	12.50
Anaconda, Mont.	Perth Amboy	12.50	.....
Butte, Mont.	Perth Amboy	12.50	.....
Humboldt, Ariz.	Chrome, N. J.	14.50	12.50
Douglas, Ariz.	Perth Amboy	14.50	12.50
Globe, Ariz.	Perth Amboy	14.50	12.50
Clifton, Ariz.	Perth Amboy	14.50	12.50
Clarkdale, Ariz.	Chrome, N. J.	14.50	12.50
Via Southern S.S. Co. or Morgan Line		.....	$9.40
Copperhill, Tenn.	Laurel Hill, N. Y.	$10.80	.....
Tooele, Utah	Chrome, N. J.	12.50	.....
McGill, Nev.	Baltimore, Md.	12.90	.....
Houghton, Mich.	New York	9.60	.....
Hancock, Mich.	New York	9.60	.....
Hubbell, Mich.	New York	9.60	.....
Dollar Bay, Mich.	New York	9.60	.....
Via Canal			
Anaconda, Mont.	Tacoma, Wash.	7.09	.....
Ajo, Ariz.	New York	14.50	$12.50

Marine Freight Rates

New York to

Hamburg	$4.50	per gross ton copper and lead
Liverpool	6.32½	per gross ton copper and lead
Antwerp	4.00	per gross ton copper and lead
Havre	4.75	per gross ton lead
	5.00	per gross ton copper

Gulf ports to

Hamburg	$4.50	per gross ton copper and lead
Liverpool	5.50	per gross ton copper and lead
Antwerp	4.00	per gross ton copper and lead
Havre	5.00	per gross ton copper

Pacific coast ports to

Hongkong	$6.00	per short ton copper and lead
Kobe	6.00	per short ton copper and lead

Lead Bullion (Pig Lead Where Shown)

From	Rates per Ton of 2,000 Lb. To New York	To St. Louis
East St. Louis, Ill.	$7.00	.....
Pueblo, Colo.	12.50	$9.00
Leadville, Colo.	12.50	9.00
East Helena, Mont	12.50	9.50
El Paso, Tex.	10.00 Via Gulf	
	12.00 All Rail	7.00
Omaha, Neb.	9.60	3.65
Murray, Utah	12.50	9.00
Midvale, Utah	12.50	9.00
Tooele, Utah	12.50	9.00
East Chicago, Ill.	6.40	(a) 1.60
Kellogg, Idaho	13.50	9.50
Carnegie, Pa.	3.80	(a) 5.00
Selby, Calif.	(b) 6.00	.....
Herculaneum, Mo.	(a) 8.80	(a) 1.80
Federal, Ill.	7.00	(a) 1.80
Collinsville, Ill.	7.00	(a) .75½
Granby, Mo.	(a) 10.50	(a) 3.50
Joplin, Mo.	(a) 10.50	(a) 3.50

(a) Pig lead only.
(b) Conference rate, via canal.

Slab Zinc

From	Rates per Net Ton to E.St. Louis	New York
Donora, Pa.	(a) $4.60	$3.80
Langeloth, Pa.	(a) 4.60	3.80
Palmerton, Pa.	7.10	3.00
Hillsboro, Ill.	1.40	7.00
Danville, Ill.	1.60	6.40
La Salle, Ill.	1.60	6.70
Springfield, Ill.	3.00	7.00
Cleveland, Ohio	5.80	5.00
Moundsville, W. Va.	4.40	3.80
Van Buren, Ark.	3.80	10.80
Fort Smith, Ark.	3.80	10.80
Bartlesville, Okla.	3.50	10.50
Blackwell, Okla.	3.80	10.80
Henryetta, Okla.	3.80	10.80
Sand Springs, Okla.	3.80	10.80
Cherryvale, Kan.	3.50	10.50
Black Eagle, Mont.	9.40	12.50
Park City, Utah	9.00	12.50
Amarillo, Tex	5.80	12.80

(a) To St. Louis, Mo.

Zinc Ores and Concentrates

To	From	Rate per Net Ton
Bartlesville, Okla.	Altoona, Kan.	$2.10
	Pittsburg, Kan.	1.09
	Galena, Kan.	1.30
	Joplin, Mo.	1.40
	Iola, Kan.	1.09
	Baxter, Kan.	1.50
	Miami, Okla.	1.40
	Quapaw, Okla.	1.40
	Kansas City, Mo.	1.60
Sand Springs, Okla.	Miami, Okla.	2.20
	Quapaw, Okla.	2.20
	Galena, Kan.	1.50
	Joplin, Mo.	1.50
	Iola, Kan.	2.40
Dewar, Okla.	Cave Springs, Mo.	2.00
Kusa, Okla.	Cent City Spur, Mo.	2.00
Henryetta, Okla.	Chitwood, Mo.	2.00
	Galena, Kan.	1.50
La Harpe, Kan.	Mound City, Kan.	.50
	Oswego, Kan.	.50
	Parsons, Kan.	.50
Coffeyville, Kan.	Galena, Kan.	1.10
	Joplin, Mo.	1.22
Bartlesville, Okla. (a)	Baxter, Kan.	1.80
	Miami, Okla.	1.80
	Quapaw, Okla.	1.80

(a) Lead ore and concentrates.

Rates on Ores and Concentrates

From	To	Value of Product Rate $5	$10	$15	$20	$25	$30	$35	$40	$50	$60	$70	$75	$80	$90	$100
Butte, Mont.	Anaconda, Mont.	.22	.22	.22	.22	.22	.22	.22	.22	.22	.22	.22	22	.22	.22	.22
Butte, Mont.	Black Eagle, Mont. (a)	....	....	....	....	....	....	....	1.01	....	....	....	....	....	....	1.01
Great Falls, Mont.	East Helena, Mont (.)	....	....	1.50	....	1.69	....	1.91	....	2.36	....	....	....	....	....	2.48
Butte, Mont.	East Helena, Mont.	....	....	1.17	....	1.46	....	1.69	....	2.03	....	....	....	....	....	2.14
Paxton, Calif.	Salt Lake Smelters, Utah	....	....	....	....	....	....	....	....	5.50	6.00	6.70	....	7.40	8.10	8.80
Johannesburg, Calif.	Selby, Calif.	....	....	....	2.90	....	3.50	....	4.10	4.70	5.30	5.90	....	6.50	6.80	7.10
Johannesburg, Calif.	Humboldt, Ariz.	....	....	....	3.40	....	4.10	....	4.80	5.50	6.20	6.90	....	7.60	8.00	8.30
Pioche, Nev.	Humboldt, Ariz.	....	4.50(c)	7.74	....	8.55	....	9.36	....	9.99	....	....	11.25	....	....	12.42
Creede, Colo.	Durango, Colo.	....	....	3.25	3.50	3.75	4.00	....	4.25	4.75	5.25	5.75	6.05	....	....	7.10
Ouray, Colo.	Durango, Colo.	....	....	4.30	4.80	....	5.05	....	5.50	5.90	....	6.30	....	....	....	7.70
Telluride, Colo.	Durango, Colo	....	....	....	....	....	4.30	....	5.00	5.50	6.00	6.5	....	6.60	7.10	7.70
Silverton, Colo.	Durango, Colo	....	....	1.40	1.40	....	....	2.20	....	....	....	....	....	2.30	2.55	2.80
Tyrone, N. M.	Douglas, Ariz.	....	....	1.60	1.90	....	2.20	....	2.50	2.80	....	..	3.10	....	....	3.40
Tyrone, N. M.	El Paso, Tex.	....	....	1.60	1.90	....	2.20	....	2.50	2.80	....	..	3.10	....	....	3.40
Lordsburg, N. M.	Douglas, Ariz.	....	1.00	....	1.60	....	1.90	....	2.20	2.50	....	....	2.80	....	....	3.40
Lordsburg, N. M.	El Paso, Tex.	....	1.00	1.30	1.60	....	1.90	....	2.20	2.50	....	....	2.80	....	....	3.40
Tombstone, Ariz.	Douglas, Ariz.	....	....	.60	....	.90	....	....	....	1.30	....	....	1.60	....	....	1.90
Tombstone, Ariz.	El Paso, Tex.	....	1.60	1.90	....	2.50	....	....	....	3.80	....	....	4.40	....	....	4.40
Silver City, N. M.	Douglas, Ariz.	....	....	2.48	....	3.15	....	....	....	3.83	....	....	....	....	....	5.29
Ray Junction, Ariz.	Hayden, Ariz.	....	.10	....	.40	....	.50	....	.80	.90	....	....	1.00	....	....	1.10
Sandon, B. C. / Alamo Concentrator, B. C.	Tadanac, B. C.	1.50	1.60	1.70	1.90	2.00	2.50	....	2.60	2.90	3.40	3.50	....	3.70	3.80	3.90
Rossland, B. C.	Tadanac, B. C.	.90	.90	1.00	1.00	1.10	1.50	....	1.60	1.60	1.60	1.70	....	1.70	1.70	1.70
Rossland, B. C.	Tadanac, B. C(e)	.30	.30	.30	.30	.50	.70	....	.80	.80	....	....	....	....	....	....
Republic, Wash.	Tadanac, B. C.	....	2.11	2.56	2.66	2.86	3.84	....	3.84	3.84	4.69	4.89	....	5.19	5.39	5.59

(a) Minimum tonnage of 200 tons per day. (b) In open cars, minimum 80,000 lb. (c) Siliceous ore tailing. (d) Plus $2.70 per car switching.
(e) Applicable on ore, only when shipped in trainload lots of not less than 10 cars and exclusive of switching charges at Rossland.

From	To	Value of Ores and Concentrates Rate $10	$15	$20	$25	$30	$35	$40	$50	$60	$70	$75	$80	$90	$100
Burke, Idaho (a) (d)	Bradley, Idaho	....	....	....	....	....	....	....	....	.68	....	.....	....	.....	1.02
Burke and Wallace, Idaho	East Helena, Mont.	....	....	....	....	3.00	....	3.25	3.50	3.75	4.00	.....	4.25	4.50	4.75
Sagel, Idaho	East Helena, Mont.	....	....	....	3.38	....	3.83	....	4.16	....	....	.....	....	.....	4.84
Arizona Tunnel, Idaho	Bradley, Idaho	....	....	....	....	....	....	....	....	.35	....	.....	....	.....	.50
Bayview, Idaho	Bradley, Idaho	....	....	....	....	....	....	....	3.75	....	....	4.37½	....	.....	5.12
Park City, Utah	Salt Lake Smelters	1.00(e)	1.10	1.25	....	1.50	....	1.75	....	2.00	....	.....	2.25	.....	2.50
Eureka, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
Tintic, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
St. Johns, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
Ophir, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
Bingham, Utah	Garfield, Utah	....	.40	....	.75	....	....	....	.95	....	....	1.10	....	.....	1.25
Cherry Creek, Nev.	Garfield, Utah (c)	....	....	4.60	....	5.10	....	5.60	6.10	6.60	7.10	.....	7.60	8.10	8.60
Cherry Creek, Nev.	Garfield, Utah (b)	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	.....	7.40	.....	.....
Goldfield, Nev.	Salt Lake Smelters	....	4.15	5.10	....	5.80	....	6.50	7.20	7.90	8.60	.....	9.30	10.00	10.70
Battle Mountain(a)	Salt Lake Smelters	....	....	3.20	....	3.80	....	4.40	5.00	5.60	6.20	.....	6.80	7.40	8.00
Palisade, Nev. (a)	Salt Lake Smelters	2.20	2.90	3.20	....	3.80	....	4.30	4.80	5.30	5.80	.....	6.30	6.80	7.30
Mina, Nev. (a)	Salt Lake Smelters	....	....	3.60	....	4.30	....	5.00	5.70	6.40	7.10	.....	7.80	8.50	9.20
Lovelock, Nev. (a)	Salt Lake Smelters	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	.....	7.40	8.10	8.80
Golconda, Nev. (a)	Salt Lake Smelters	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	.....	7.40	8.10	8.80
Hazen, Nev. (a)	Salt Lake Smelters	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	.....	7.40	8.10	8.80
Tonopah, Nev.	Salt Lake Smelters	....	4.15	5.10	....	5.80	....	6.50	7.20	7.90	8.60	.....	9.30	10.00	10.00
Rogerson, Idaho	Salt Lake Smelters	3.00	....	3.50	....	4.00	....	4.50	5.00	5.50	6.00	.....	6.50	7.00	7.07
Georgetown, Colo.	Leadville, Colo.	....	....	3.50	....	3.75	....	4.00	5.00	5.00	5.80	.....	5.80	5.80	5.85

(a) Minimum weight, marked capacity of car used, but not less than 80,000 lb. (b) Minimum weight, 80,000 lb. (c) Minimum weight, 40,000 lb.
(d) Crude ore for concentration, 30c. per ton.
(e) For $9 value rate is 95c.; $8 values, 90c.; $7 value, 85c.; $6 value, 80c.
* Indicates a change of tariff since June 19.

Mining Stocks—Week Ended September 25, 1926

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	49⅛	48⅛	48¼	Jy.17, Au.23 Q	0.75
Arcadian Consol.	Boston	*90	*80	*90		
Ariz. Com'l.	Boston	11	11	11	Jy. 16, Jy. 30	0.50
Calaveras	N. Y. Curb	...	...	1¼		
Calumet & Arizona	New York	69	66½	67½	Se. 4, Se. 20 Q	1.50
Calumet & Hecla	Boston	18⅛	17⅛	17⅛	Au.31, Se.15 Q	0.50
Cerro de Pasco	New York	69⅛	64⅛	64⅝	Jy. 15, Au. 2, Q	1.00
Chile Copper	New York	33⅛	32⅛	32⅛	Se.1, Se.27, Q	0.62½
Con. Coppermines	N. Y. Curb	3	2⅞	2⅞		
Copper Range	Boston	16⅛	16	16⅛	May, 1925	1.00
Crystal Copper	Boston Curb	*50	*42	*48		
East Butte	Boston	3	2¼	3	Dec., 1919	0.50
First National	Boston Curb	...	...	*16	Feb., 1919	0.15
Franklin	Boston	*60	*60	*60		
Granby Consol.	New York	32⅛	30⅛	31	May, 1919	1.25
Greene-Cananea	New York	20⅛	19⅛	19⅞	Nov., 1920	0.50
Hancock	Boston	...	...	1		
Howe Sound	New York	44⅛	43	43⅛	Oc.1, Oc.15 Q	1.00
Inspiration Consl.	New York	24⅝	24⅛	24⅛	Se.16, Oc.4, Q	0.50
Iron Cap	Boston Curb	3⅜	3⅛	3⅛	Jn. 1, Jn. 15	0.50
Isle Royale	Boston	12⅛	11⅞	11¾	Jn. 1, Jn. 15	0.50
Jerome Verde Dev.	N. Y. Curb	*55	*55	*55		
Kennecott	New York	56⅛	55⅝	55⅞	Sept. 3, Oct. 1 Q	1.00
Lake Copper	Boston	*80	*75	*80	June, 1925	0.50
Magma Copper	New York	39⅜	38⅞	38⅞	Oc.1, Oc..15, Q	0.75
Mason Valley	N. Y. Curb	2⅜	2⅛	2⅛		
Mass Consolidated	Boston	*40	*30	*30	Nov., 1917	1.00
Miami Copper	New York	16⅛	15	16⅛	Aug.2, Aug.16 Q	0.25
Mohawk	Boston	41⅞	40⅛	40⅛	Jy.31, Se.1 Q	1.00
Mother Lode Coa.	New York	5⅞	5⅜	5⅞	Jn. 15, Jn. 30	0.37½
Nevada Consol.	New York	13⅛	13	13⅛	Oc.14, Nov.16	0.75
New Cornelia	Boston	22⅜	22	22⅜	Au 6, Au.23 Q	0.04
North Butte	Boston	3⅞	21⅝	3¼	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*51	*50	*51	Se. 1, Se. 15	0.05
Old Dominion	Boston	...	...	17⅛	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†135	†132	...	Sc.25, Oc.2 Q	1.50
Quincy	Boston	20	19⅛	19⅞	Mar., 1920	1.00
Ray Consolidated	New York	14	13⅞	14	Ap.20, Ap.30	0.25
Ray Hercules	N. Y. Curb	...	...	11⅞		
St. Mary's Min. Ld.	Boston	29	28	28⅛	Ap.17, My.18	2.00
Seneca Copper	New York	5⅛	5⅛	5¼		
Shannon	Boston	*40	*40	*40	Nov., 1917	0.25
Shattuck-Denn	Boston Curb	6⅛	6⅛	6⅛		
Superior & Boston	Boston	*60	*45	*60		
Tenn. C. & C.	New York	12⅛	11⅛	11⅛	Au.31, Se.15 Q	0.25
United Verde Ex.	N. Y. Curb	26	25⅝	25⅞	Oc.16, No. 1, Q	0.75
Utah Copper	New York	...	...	104	Se.3, Se.17 Q	1.75
Utah Metal & T.	Boston	2	1 1/16	2	Dec., 1917	0.30
Victoria	Boston	...	...	*50		
Walker Mining	Salt Lake	*62	*60	*62		
NICKEL-COPPER						
Internat. Nickel	New York	36⅞	35⅝	36½	Se.7, Se.30, Oc.1 Q	0.50
Internat. Nickel, pfd.	New York	...	...	102	Jy.12, Au.12,	1.50
LEAD						
Gladstone M. M. Co.	Spokane	*33	*31⅛	*33	Jy. 10, Au.10	0.01½
National Lead	New York	155	155	155	Jn. 11, Jn. 30 Q	2.00
National Lead pfd.	New York	116⅛	116⅛	116⅜	My.21, Je.15 Q	1.75
St. Joseph Lead	New York	41⅞	40⅛	40⅛	Jn.10, Jn.21 QX	0.75
ZINC						
Am. Z. L. & S.	New York	6⅞	6¾	6⅞	May., 1920	1.00⅞
Am. Z. L. & S, pfd.	New York	34	32	33⅓	Nov., 1920	1.50
Butte C. & Z.	New York	4⅞	4⅛	4⅛	De.10, De.24	0.50
Butte & Superior	New York	9⅜	9⅛	9⅛	Se.15, Se.30 Q	0.50
Callahan Zn-Ld.	New York	1⅞	1⅞	1⅞	Dec., 1920	0.50
Eagle Picher	Cincinnati	32	30⅞	30⅞	Au.14, Se.1 Q	0.40
Eagle Picher, pfd.	Cincinnati	....	....	110	Aug.20, Sept.15 Q	1.75
New Jersey Zn.	N. Y. Curb	...	...	191	July 20, Aug.10 Q	2.00
United Zinc	N. Y. Curb	....	....	*70		
Yellow Pine	Los Angeles	*23¾	*15	*23¾	De.8, De.18 Q	0.04
GOLD						
Alaska Juneau	New York	1	1	1		
Argonaut	Toronto	*30⅜	*27	*30⅜		
Barry-Hollinger	Toronto	*65	*64	*65		
Carson Hill	Boston	*25	**25	*25		
Consol. W. Dome L.	Toronto	*22½	*21¼	*21½		
Cresson Consol. G.	N. Y. Curb	2⅛	2⅛	2⅛	Mh.31, Ap.10	0.10
Crown Reserve	Toronto	*9⅛	*9	*9⅛	Jan., 1917	0.05
Dome Mines	New York	...	...	10⅜	Se.20, Oc. 30, Q	0.50
Golden Center	N. Y. Curb	2⅛	2	2		
Golden Cycle	Colo. Springs	...	...	2	Nov.30, Dec.10 Q	0.03
Hollinger Consol.	Toronto	19.25	19.10	19.15	Se.21, Oc. 7 Q	0.10
Homestake Mining	New York	59⅛	59⅛	59⅞	Se.20, Se.25 M	0.50
Kirkland Lake	Toronto	1.10	*99⅛	1.00		
Lake Shore	Toronto	13.95	13.65	13.75	Se.1, Se. 15 Q	0.10
McIntyre-Porcupine	New York	24⅛	24⅛	24⅛	Au.2, Se.1 Q	0.25
Newray	Toronto	...	...	*40		
Noranda	N. Y. Curb	*19½	*17⅞	*18		
Night Hawk Pen.	Toronto	*7⅞	*7	*7⅞		
Portland	Colo. Springs	...	...	*43	Oc.6, Oc.15	0.02
Rand Mines	New York	40	39	40	Au.23–30 Am.Sh.	1.52
Teck-Hughes	Toronto	4.53	4.46	4.46	Jy. 15, Au. 2	0.05
Tom Reed	Los Angeles	*61	*60	*60	Ma.10 Ma.20	0.02
Tough-Oakes	Toronto	*44½	*42½	*44		
United Eastern	N. Y. Curb	*55	*49	*50	July, 1924	0.05
Vipond Cons.	Toronto	1.74	1.70	1.72		
Wright-Hargreaves	Toronto	8.75	8.60	8.68	Se.15, Oc.1 QX	0.07½
Yukon-Alaska Trust	N. Y. Curb	...	...	21		
GOLD AND SILVER						
Carnegie Metals	Boston	...	...	12½		
Con. Cortez	N. Y. Curb	*7	*7	*7		
Con. Virginia	San Francisco	*11	*8½	*9½		
Continental Mines	N. Y. Curb	....	....	*48		
Dolores Esperanza	N. Y. Curb	*94	*90	*92	July, 1923	0.05
Premier Gold	N. Y. Curb	...	...	2⅛	Se.15, Oc.4 Q	0.08
Tonopah Belmont	N. Y. Curb	3 3/16	3	3	Se.15, Oc.1	0.05
Tonopah Extension	N. Y. Curb	....	....	*46	Apr. 1925	0.05
Tonopah Mining	N. Y. Curb	....	....	5⅛	Se.30, Oc.27 Q	0.07½
Unity Gold	N. Y. Curb	....	....	*30		
West End Consol.	N. Y. Curb	....	....	*18	Mar., 1923	0.05
Yukon Gold	N. Y. Curb	....	....	*27	June, 1918	0.02

Stock	Exch.	High	Low	Last		Last Div.
SILVER						
Alvarado	N. Y. Curb	....	....	1	Oct., 1920	0.50
Beaver Consol.	Toronto	*90	*83	*85	May. 1920	0.03
Castle-Trethewey	Toronto	1.43	1.39	1.39		
Coniagas	Toronto	4.30	4.15	4.15	May, 1924	0.12½
Keeley	Toronto	1.66	1.62	1.63	Se. 1, Se.15 X	0.12
Kerr Lake	N. Y. Curb	1⅛	1⅛	1⅛	Oc.1, Oc.15	0.12½
La Rose	Toronto	*8	*8	*8	Apr., 1922	0.10
Lorrain Trout Lake	Toronto	...	...	*50	Jy. 2, Jy. 15	0.05
McKinley-Dar.-Sav.	Toronto	*12⅞	*11	*11	Oct., 1920	0.03
Mining Corp. Can.	Toronto	3.60	3.40	3.54	Jy.1, Jy.15 Q	0.12½
Nipissing	N. Y. Curb	6⅞	6	6⅛	Se.30, Oc.20 Q	0.15
Temiskaming	Toronto	...	...	*8	Jan., 1920	0.40
SILVER-LEAD						
Ahumada	New York	7¾	7⅛	7⅛	Se.28, Oc.1, QX	0.25
Alta Merger	Salt Lake	†4	†2	...		
Bingham Mines	Boston	41⅞	40⅞	40⅛	Se.20, Se.30 Q	1.00
Cardiff M. & M.	Salt Lake	*34	*34	*34	De.16, No.18	0.10
Chief Consol.	Salt Lake	3.00	3.00	3.00	Jy.10, Au.10 Q	0.10
Consti'n Mng. & Mill'g	Spokane	*52	*49	*50		
Emma Silver	Salt Lake	†1	†*50	...		
Erupcion	Boston Curb	1 1/16	1 1/16	1 1/16	Se., Oc.1, QX	0.15
Federal M. & S.	New York	...	...	82		
Federal M. & S., pfd.	New York	73⅛	72⅛	72⅛	Au.25, Se.15 Q	1.75
Hawthorne Mines	N. Y. Curb	*13	*10	*12		
Hecla Mining	N. Y. Curb	17⅞	17⅜	17⅞	Au.14, Se.15 Q	0.50
Highland—Surprise	Spokane	*18½	*18½	*18½		
Iron King Mining	Salt Lake	...	...	*29½		
Keystone Mining	Salt Lake	*26	*26	*26	Au.12, Au.26	0.07½
Lucky Jim	Spokane	*16½	*16	*16½		
Lucky-Tiger Com.	Kansas City	†9.20	†9.00	...	Se.10, Se.20 X	0.07
Mammoth Mining	Salt Lake	3.02½	3.02½	3.02½	Mar.24, Apr. 1	0.10
Marsh Mines	Spokane	2.25	2.00	2.12½	Se.15, Oc.19	0.15
Park Utah	New York	6.59½	6.59½	6.59½	Se.15, Oc.1 Q	0.15
Plutus Mining	Salt Lake	....	....	1.90	July 15	0.10
Prince Cons.	Salt Lake	*4⅞	*3	*3		
Silver King Coal.	Salt Lake	7.85	7.75	7.75	Jn. 21, July 1, Q	0.25
Silversmith	Spokane	*50½	*50	*50½	Jn.30, Jy.10 Q	0.02
Strattons Mines	Spokane	*40	*37	*40		
Tamarack-Custer	Spokane	*27	*27	*27	Sept., 1924	0.25
Tintic Standard	Salt Lake	11.87	11.62	11.75	Se.13, Se.25 QX	0.40
Utah-Apex	Boston	7⅛	6⅞	6⅞	Jy.3, Jy.15 Q	0.25
Western Utah Copper	N. Y. Curb	....	....	*5		
IRON						
Bethlehem Steel	New York	51⅛	49⅛	50	July, 1924	1.25
Cleveland-Cliffs Iron	Cleveland	82	80	80⅛		
Colorado Fuel & Iron	New York	45⅛	44	44⅛	May, 1921	0.75
Gt. North'n Iron Ore	New York	20⅞	19⅞	19⅞	De. 4, De. 28,	0.75
Inland Steel	New York	41⅛	40⅛	41⅛	Au.13, Se.1 Q	0.62½
Mesabi Iron	N. Y. Curb	1⅛	1⅛	1⅛		
Replogle Steel	New York	10⅛	9⅛	9⅞		
Republic I. & S.	New York	60	57⅞	60	Au.14, Se.1	1.00
Republic I. & S. pfd.	New York	...	...	99	Se.15, Oc.1 Q	1.75
U. S. Steel	New York	132	125	132	Se.10, Se.20 Q	1.50
Sloss-Sheffield S. & I.	New York	104	104	104	Se 20, Oc.1 Q	1.75
Sloss-Shef. S.&I. pfd.	New York	104	104	104	Se 20, Oc.1 Q	1.75
U. S. Steel	New York	150⅛	142⅛	149⅜	Se.2, Se.29 Q	1.75
U. S. Steel pfd.	New York	127⅛	126⅛	126⅞	Au.3, Au.30, Q	1.75
Virginia I. C. & C.	New York	47	47	47	Jan., 1924	1.50
Virginia I.C.&C.pfd	New York	...	...	72	Jn.1, July 2,	2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM						
De Beers Consol.	New York	...	...	38	Ju.16, Ju.17	1.70
So. Am. Gold & P.	N. Y. Curb	4⅛	4⅛	4⅛		
Alum. Co. of Amer.	N.Y.Curb	71⅛	69⅞	71⅛		
Alum. Co. of Amer pf.	N.Y.Curb	...	...	69	June 15, July 1, Q	1.50
Vanadium Corp.	New York	40⅛	38⅛	40	Au.2, Au.16, Q	0.75
ASBESTOS						
Asbestos Corp., New	Montreal	23⅛	21	21⅜	De.31, Ja.15 Q	1.50
Asbestos Corp., pfd.	Montreal	78	76⅛	77⅛	Jy.1, Jy.15, Q	1.75
SULPHUR						
Freeport Texas	New York	29⅛	24⅛	28⅜	Nov., 1919	1.00
Texas Gulf	New York	178⅛	166	177⅞	Se.7, Se. 15, Q	3.00
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	50	49⅜	49⅜	Au.20, Se. 1, Q	1.00
Amer. Metal pfd.	New York	...	...	114	Au.21, Se. 1 Q	1.75
Amer. Sm. & Ref.	New York	147⅛	139	139⅛	Jy.10, Au.2, Q	1.75
Amer. Sm.&Ref.pfd.	New York	119	119	119	Au.7, Se.1, Q	1.75
Consol. M. & S.	N. Y. Curb	...	...	3	Jn.30, Jy.5 QX	3.75
Federated Metals	N. Y. Curb	12⅞	12⅜	12⅜		
Newmont Mining	N. Y. Curb	68	66	68	Oc.1, Oc.15,	0.60
Southwest Metals	N. Y. Curb	...	...	1		
U. S. Sm. R. & M.	New York	37⅛	32	35⅛	Jy. 7, Jy. 15, Q	0.87½
U. S. Sm. R.&M.pfd.	New York	48⅝	48⅛	48⅛	Jy. 7, Jy. 15, Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Henry Sachs, Colorado Springs, Colo.

PRICE WEEK ENDED SEPT. 14, 1926

Name	High	Low	Last	Last Divd. Date	Amount
Aramayo Mines (25 frs.)	80/7½	77/9	80/—	Aug. 1926	15 p.c.†
British Platinum (£1)	3/10½	3/—	3/9	Feb. 1925	2½ p.c.
Burma Corpn. (10 rupees)	16/3	15/6	16/3	Aug. 1926	7 annas*
Bwana M'Kubwa (5s)	7/6	7/—	7/1½		
Camp Bird (2s)	4/7½	3/9	3/9		
El Oro (£1)	8/3	7/—	7/3	Nov. 1924	2½ p.c.*
Esperanza (10s)	1/—	—/9	—/9		
Frontino & Bolivia (£1)	8/3	7/—	7/6	July 1926	2½ p.c.
Mexican Corpn. (£1)	14/1½	13/3	13/9		
Mexico Mines of El Oro (£1)	26/3	25/—	26/3	June 1926	7½ p.c.*
Oroville Dredging (£1)	3/9	3/3	3/9	Dec. 1923	3¾ p.c.
Ouro Preto (£1)	2/1½	2/—	2/—	May 1925	2½ p.c.
Rhodesian Congo Border (£1)	118/9	114/4½	117/6		
St. John del Rey (£1)	9/—	8/3	8/6	June 1925	6½ p.c.
San Francisco Mines (10s)	34/7½	33/6	34/4	June 1926	15 p.c.
Santa Gertrudis (£1)	18/7½	17/3	17/9	July 1926	5 p.c.
Selukwe (2s. 6d.)	12/7½	11/7½	12/7½	April 1917	6¾ p.c.
S. Amer. Copper (2s.)	4/6½	3/10½	4/3	Nov. 1917	75 p.c.
Tanganyika (£1)	49/9	45/—	46/3	Aug. 1926	7½ p.c.
Tomboy (£1)	3/7½	3/4½	3/6	July 1926	10 p.c.
Union Miniere du Haut-Katanga (Brussels)	9.675	9.400	9.650	July 1926	175 (‡)

* Free of British income tax. † Swiss frs. ‡ Belgian frs.